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THE GENERIC NAMES OF BACTERIA

By
ELLA M. A. ENLOWS

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CONTENTS.

	Page.
Introduction and acknowledgments	5
Early attempts at classification	8
Generic names	11
Alphabetical list of species	101

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THE GENERIC NAMES OF BACTERIA.

By ELLA M. A. ENLOWS, *Bacteriologist, United States Public Health Service.*

The list of generic names submitted here is as complete as careful search through bacteriological literature can make it. If further time were available additional names might be found. However, those familiar with the voluminous bacteriological literature of to-day will realize that the omission of a name is not intentional nor the result of neglect.

The work was begun [in the Laboratory of Dr. Erwin F. Smith, U. S. Department of Agriculture] in 1915 with Mr. E. C. Kellogg, then biological chemist, Bureau of Plant Industry, who was obliged to discontinue it on entering the service of the United States Army. It is only at his request that his name is not included in joint authorship. Several of the German translations were made by him, and the author acknowledges her indebtedness. A number of names were furnished by Capt. M. W. Lyon, jr., Medical Corps, United States Army, who also suggested the problem and assisted greatly throughout the work by much helpful criticism.

I am indebted to Mr. Conrad Kinyoun, of the Hygienic Laboratory, for much valuable assistance in reading the proof of this manuscript. Also, much gratitude is expressed for the assistance received from my husband, Mr. H. F. Enlows. His aid in the translation from Spanish and Portuguese, and in proof reading was extremely helpful.

Many valuable criticisms have been received from Dr. C. W. Stiles, Assistant Surgeon General, United States Public Health Service, particularly with reference to type citation. The species index was also arranged at his suggestion. The rules governing type citation which the author has endeavored to follow are those outlined by Dr. Stiles in "The International Code of Zoological Nomenclature as Applied to Medicine," Hygienic Laboratory Bulletin No. 24, Washington, D. C., September, 1905, pages 26 to 28. The different articles of the Botanical Code (International Rules of Botanical Nomenclature, Vienna, 1905, and Brussels, 1910. See also Rhodora, v. 9, No. 99, pp. 29–52, Providence, 1907) point out many ways in which numerous genera here listed should fall by the wayside. Binomial combinations frequently are not considered essential by authors forming these genera, simply the generic name being used, or

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an unsightly, "phonetically discordant" trinomial is written. In such cases further search has been undertaken in an effort to find the earliest binomial combination, and those which have been found are included.

Descriptions of the genera, though in many instances meager and indefinite, are included; in these descriptions morphology plays the chief rôle, largely because the earlier bacteriologists laid little or no emphasis upon constant physiological differences. It is to be hoped that the many inadequately defined genera here listed may serve as glowing examples of errors to be avoided by future contributors. A plea is made, too, for the introduction of generic names which are descriptive, since names of this sort define and, in a way, classify. Proper names converted by the addition of "inia," "ella," etc., as, for example, in *Pasteurella*, are very alluring because of their acknowledgment of the debt we owe our leaders, but they are not descriptive terms and offer no aid whatever to any system of classification. Terms such as *Aplanobacter*, *Rhodococcus*, *Hemophilus*, etc., are definitely descriptive. However, the majority of investigators agree that merely a name which is stable is sufficient. In fact, the committee on classification of the Society of American Bacteriologists (J. Bact., v. 2, No. 5, Baltimore, 1917, p. 530) state that "The name need not be appropriate; it need only be stable. It is an arbitrary label, not a description." Dr. C. W. Stiles (Hygienic Laboratory Bull. 23, Washington, D. C., 1905, p. 44) expressed a similar view a number of years earlier: "It is essential to recall that names are not definitions; they are simply handles by which objects are known." A divergence of opinion with such distinguished investigators is expressed with the utmost respect for their views, and not with any suggestion of making changes in names of universal acceptance. The writer does feel, however, that future classification will be easier and will more adequately fulfill the purpose of classification—that of simplifying our surroundings—if the new names introduced are well-chosen, descriptive terms. We are living in a busy age, when even minutes are jealously guarded. If a few letters can be rearranged so that they tell us several facts instead of one, why not use the better combination? *Streptococcus hemolyticus* certainly is rich in meaning compared with *Jonesiella browningi*.

The descriptions have been taken from the original texts when these could be procured anywhere in the United States. Otherwise the authority is given supporting the description quoted.

The author's own words have been inserted where there was any doubt as to the meaning. It should not be forgotten that in the [illegible] days of bacteriology but little was known about these [illegible]nts, and the published information concerning them is

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in many cases so meager and so frequently contradictory that it is very difficult to isolate facts. The earlier bacterial genera were included among animals of various types and they are with difficulty separated. The first descriptions are those of Müller, who in 1773 published descriptions of these minute organisms as a part of the group of infusoria, *Infusoria crassiuscula*, establishing the two genera *Monas* and *Vibrio*. He defines them as "simple, inconspicuous worms." Bory de Saint-Vincent in 1824–1830, in his classification of the "Animaux Microscopiques," placed the bacteria in two different families of the order Gymnodes—Vibrionides and Monadaires.

Ehrenberg in 1828 defined the genus *Bacterium*, placing it among the "Phytozoa," family Vibrionia of the large class "Animalia Evertebrata." In 1838 (Die Infusionsthierchen) he retained the family name Vibrionia, and included under it the 5 genera: *Bacterium*, *Vibrio*, *Spirillum*, *Spirochaeta*, and *Spirodiscus*, excluding at this time *Monas* Müller. His description of the Vibrionia is interesting: "Animals, filiform, distinctly or apparently polygastric, no mucous membrane, naked, without external organs, with the body uniform or united in chains or filiform series as a result of incomplete division." The presence or absence of the more or less numerous stomachs which he ascribes to some of his species, together with the "proboscis" and "tail" occasionally mentioned, evidently have a more modern interpretation. His drawings, however, are excellent, often very illuminating, and more to the point than his lengthy descriptions.

The family Vibrionia was retained by Dujardin (1841) among the infusoria, and characterized as follows: "Animaux filiformes extrêmement minces, sans organisation appréciable, sans organes locomoteurs visibles." Under his definition of *Spirillum*, *Spirochaeta plicatilis* Ehrenberg became *Spirillum plicatile*.

Robin (1853) was one of the first investigators to point out the relationship of the bacteria to *Leptothrix*, then described as a plant. Davaine, also, in 1859, pointed out that the "vibrioniens" were "vegetables," closely related to the algæ, and especially to the Confervae. He included under the "Bactéries": *Bacterium*, *Vibrio*, *Spirillum*, and his new genus *Bacteridium*. Following Davaine, Hoffmann in 1869 demonstrated that the bacteria are plants possessing a very distinct cellular organization, and classified them according to their form and size into monads and linear bacteria, subdividing the latter into microbacteria, mesobacteria, and megabacteria. He included *Leptothrix* among the linear bacteria. Motility he decided to be a nonspecific characteristic, since it varied with temperature, density of medium, etc. Hallier's voluminous papers (1866–70) on the microorganisms found in several contagious diseases,

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though indefinite and confusing, undoubtedly brought the spherical bacteria into prominence, as Hoffmann, Cohn, and Billroth adopted at once his name *Micrococcus* for the round forms.

Nägeli in 1857 believed that the bacteria belonged with the fungi and coined the name Schizomycetes. Cohn, to whom is due the credit for the first "usable" classification, several times discussed the relation of the bacteria to the fungi and to the algæ, and concluded that if the absence of chlorophyll alone is to place a genus either with the algæ or with the fungi, then the greater part of the genera of bacteria must go with the fungi.

Cohn's first classification was based chiefly upon the presence or absence of zoogloeae (Beiträge z. Biol. d. Pflanz. v. 1, H. 2, 1870–1875). Later (idem, H. 3) he classified the bacteria with the algæ, placing them under the "Schizophytes," including all the lower plant forms, provided or not with chlorophyll, multiplying by fission. He formed two tribes: Gloegenae (nonfilamentous) and Nematogenae (filamentous), and placed each bacterial genus beside its nearest algal relative.

Zopf, in 1883, separated the fission-fungi from the fission-algae. He made four large groups: Coccaceae, bacteriaceae, leptothriceae, and cladothriceae, and greatly emphasized pleomorphism. Zopf in his classification also differentiated the spore-forming and the non-spore-forming organisms. Van Tieghem and de Bary followed in the footsteps of Zopf. De Bary (1884) made two large groups: Organisms producing endospores, and those producing arthrospores.

Hüeppe followed Zopf, but separated the spiral forms, forming the new group: Spirobacteriaceae.

Thaxter in 1892 added to the groups then included under the bacteria organisms characterized by a strong resemblance to the Myxomycetes, which he placed under a new family of the bacteria: Myxobacteriaceae (see *Myxobacter* and *Myxococcus*).

Migula in 1894 substituted motility for spore formation as a distinctive characteristic, and his classification as published in 1900 has been rather generally followed in the bacteriological literature of this country.

Morphology and spore formation were used as the basis for the classification published by Lehmann and Neumann in 1896, making a separate group for the true-branching thread-like cells—Actinomycetes.

Kruse in 1896 included physiological characters in his classification, but made little use of them generically.

The most radical departure from the earlier classifications is that of Jensen in 1909 (Centralbl. f. Bakt., Abt. 2, v. 22, 1909, p. 308). makes use of the arrangement of flagella, not their presence ce, dividing the bacteria into two orders: Cephalotrichinae

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(monotrichiate or lophotrichiate), and Peritrichinae (peritrichiate or nonmotile). The former are the more primitive and are typically water organisms, deriving energy chiefly by oxidative processes, while the Peritrichinae are later forms which split carbohydrates or amino acids. He divides these orders into families and genera according to their biochemical characters. He created a number of new genera to which he assigns names formed by combining terms, e. g., "monas" for polar-flagellate rod forms, with some term expressing the chemical activity of the organism, "Methanomonas", "Carboxydomonas," etc.

The committee of the Society of American Bacteriologists on Characterization and Classification of Bacterial Types in 1917[1] proposed a new system of classification which they state "shall include what is valid and discard what is arbitrary in the older classifications—with no idealistic conceptions, either morphological or physiological in mind—but with the sole purpose of recognizing and defining the principal groups of bacteria which exhibit circumstantial evidence of common evolutionary relationship." Buchanan (J. Bact. v. 2, No. 2, March, 1917), who was a member of this committee, formed the basis of the classification by dividing the Schizomycetes into six principal groups (orders): *Eubacteriales*, *Thiobacteriales*, *Myxobacteriales*, *Chlamydobacteriales*, *Actinomycetales*, and *Spirochaetales.*

He describes these orders as follows:

1. The true bacteria which include the forms most commonly studied in the laboratory; they are probably more primitive than more highly differentiated groups.

2. The thiobacteria characterized by certain relationships to sulfur. They all grow best in the presence of hydrogen sulfide, and always contain sulfur granules or bacteriopurpurin or both.

3. The myxobacteria showing a pseudoplasmodial stage, and fruiting stages resembling in some respects those of the slime molds.

4. The iron bacteria[2] usually sheathed, frequently growing in water containing iron and with a deposit of iron oxide in the sheath; typically water forms without true branching, showing relationships with the algae.

5. The thread bacteria or ray fungi which show a filamentous form, frequently with true branching. Not water forms. As a group intergrading with the fungi.

6. The spirochetes, slender organisms usually spiral and frequently flexuous, showing many characteristics relating them to the protozoa.

Under the *Eubacteriales* he placed the families *Coccaceae*, *Bacteriaceae*, *Spirillaceae*, *Nitrobacteriaceae*. His studies on the nomenclature and classification of the bacteria,[3] in which he details the subgroups and genera of these families, contain the synonymy of many

[1] J. Bact., v. 2, No. 5, September, 1917, p. 505. See also J. Bact., v. 5, No. 3, 1920, p. 191.

[2] Ellis: Cent. Bact., abt. 2, v. 19, 576.

[3] J. Bact., v. 2, Nos. 4, 6, 1917, and v. 3, No. 1, January, 1918.

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of the generic names here included. The Winslows (Science, n. s., 1905, v. 21, p. 669; J. Infect. Dis., Chicago, 1906, 3, p. 485) also contributed to the scheme adopted by the committee on classification, in their valuable, comprehensive studies on the Coccaceae.[1]

It seems evident that the bacteria can not be classified definitely by means of either morphological or physiological characters alone, but by a happy combination of both. Variations occur in both directions, but the wonderful strides being now made in biological chemistry make it seem fairly safe to assume that in the future we shall be able to make use of physiological differences which will be constant. Possibly it would be better to say "protoplasmic" differences in order to be in harmony with the majority of modern biologists who believe that no broad line of demarcation can be made between morphological and physiological characters, since both reside in the chemical properties of the protoplasm.

In all cases of doubt as to whether a certain genus should be included among the bacterial genera listed here, the plan has been followed of retaining the name, preferring that some more skilled investigator should do the discarding. A few of those included are considered by their authors as members of the Hypomycetes or of the Protozoa, but other investigators place them among the "higher bacteria," so it seems necessary to list them as belonging to the bacteria until their life histories have been more carefully studied.

[1] See also Winslow, Rothberg, and Parsons, J. Bact., v. 5, No. 2, 1920, p. 160. Recently Orla-Jensen (Mém. de l'Acad. Roy. d. Sci. et d. Lettres de Danemark, Copenhagen, 1919, Sec. d. Sci. 8 me sér., v. 5, no. 2, pp. 81–196) has contributed an exhaustive study of the lactic acid bacteria, which he defines as including nonmotile, nonspore-forming Gram positive rods or cocci which ferment sugars chiefly to lactic acid. He divides the true lactic acid bacteria into 5 genera: *Streptococcus, Betacoccus, Thermobacterium, Streptobacterium*, and *Betabacterium*. Two other allied genera, *Tetracoccus* and *Microbacterium* are described as forming catalase, reducing nitrates and producing surface growth in stab culture. Winslow (Abstracts of Bact., v. 4, February, 1920, p. 102) thinks Jensen *Betacoccus* is the *Leuconostoc* of van Tieghem, and that his *Thermobacterium* is *Lactobacillus* Beijerinck.

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GENERIC NAMES.

Acetimonas: Jensen,[1] 1909.

Centralbl. f. Bakt., Abt. 2, v. 22, Jena, 1908–9, p. 312. Monotrichiate or nonmotile rods, forming a pellicle on liquid media, and capable of oxidizing ethyl alcohol to acetic acid and water. Includes *Bacterium aceti*, and *B. schuzenbachi* here.

Acetobacter: Beijerinck, 1898 (?).

According to Kral's Sammlung v. Mikroorg. Prague, 1898, pp. 7 and 8. *A. pastorianus* (Hansen?) Beijerinck, and *A. aceti*. See also Arch. néerl. d. sci. exact. et Nat., sér 2, v. 6, 1901, p. 212, where Beijerinck states that he uses this name for a group of organisms forming acetic acid from sugar. See also Centralbl. f. Bakt., Abt. 2, v. 29, 1911, p. 171: *A. melanogenum*, a bacterium found in sour beer, producing a brown pigment in beer gelatin.

Acetobacterium: (Beijerinck) Hoyer, 1898.

Hoyer (Beijerinck's assistant): Centralbl. f. Bakt., Abt. 2, v. 4, 1898, p. 870. *A. xylinum* (Brown). See also Ludwig, in Zeitschr. f. Pflanzenkr., v. 9, Stuttgart, 1899, p. 11.

Achromatium: Schewiakoff, 1893.

Über einen neuen Bacterienähnlichen Organismus des Susswassers. Schewiakoff. Heidelberg, 1893, 33 pp., 1 pl.

Type species (monotypy).—*A. oxaliferum*, Schewiakoff. Of all possible sizes and forms. Usually cylindrical with rounded ends; ellipsoidal and very small spheroidal forms also frequently found. Multiplication by transverse division. Varies in size from 0.15 by 0.009 mm. to 0.43 mm. by 0.009 to 0.022 mm. Only the cylindrical cells are motile. Calcium oxalate granules usually may be observed. The organism possesses a peculiar central body, surrounded by a layer of protoplasm of radial, netlike structure. He thinks this body is probably a nucleus.

Schewiakoff lays much stress upon the fact that his new genus represents an entirely new type of organism through the possession of a peculiar spherical central body having a honeycomblike, granular structure. Beyond the netlike layer of protoplasm (Rindenschicht of Bütschli) is the outer membrane which does not give the blue cellulose reaction. If the "Inhaltskörper" are dissolved in water crystals of calcium oxalate separate out.

Actinobacille: Lignières and Spitz, 1902.

Revista Soc. Med. Argentina. v. 10, Buenos Aires, 1902, p. 5. See also Bull. Soc. Cent. Med., v. 56, n. s., Paris, 1902, p. 487. Pleomorphic. Sometimes rodlike, sometimes coccuslike, in pairs; also streptobacillary forms occur; 0.15μ to 1.25μ in length by 0.4μ; nonmotile; no spores; gram negative; bipolar staining. The final stage of growth gives rise to little masses, in which the organisms are pressed closely together, giving the raylike aspect. These masses consist of a central germinative zone and an outer or vegetative zone. Cause of actinobacillosis in cattle.

[1] Throughout the text the name "Jensen" should read "Orla Jensen."

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Actinobacillus: Brumpt, 1910.

According to Précis de Parasitol. E. Brumpt, Paris, 1913, p. 963.

Names the organism described by Lignières and Spitz, 1902. Causing a disease clinically identical with actinomycosis.

Type species (monotypy).—*A. lignieresi.* Streptobacillary, bacillary or coccoidal in form. Gram negative. Never filamentous.

Actinobacter: Ducleaux, 1882.

Ann. de l'Inst. Nat. Agron., sér. 1, No. 5, 4e Ann. 1879–80, Paris. 1882, p. 110.

Type species (monotypy).—*A. polymorphus.* Polymorphic. Non-motile, very thin small rods 2 to 3μ long, surrounded by a hyalin, oval or round, gelatinous envelope 5 or 6μ long. The organism gradually passes over into very short cylinders not more than 1μ long, which are not capsulated. No capsule ever forms in Liebig's bouillon, where the organism may reach 10μ in length. Aerobic. Multiplication by transverse division. Transforms the casein of milk into a water-soiuble albuminoid, and milk-sugar into alcohol and acetic acid. Found in milk.

Actinobacterium: Haass, 1906.

Centralbl. f. Bakt., Abt. 1, v. 40, orig., 1906, p. 185. A genus closely related to *Corynebacterium* Lehmann and Neumann, *Mycobacterium* Lehmann and Neumann, and *Actinomyces* Hartz. These, together with his new genus he places in a group between the Schizomycetes and Hyphomycetes.

Actinobacterium:

A. lactis viscosum (Adametz, Ducleaux) Reitz, 1906. Centralbl. f. Bakt., Abt. 2 v. 16, Jena, 1906, p. 731.

Actinobacterium:

A, israëli, var. *spitzi* Sampietro, 1908. Ann. d. 'Ig. sperim. v. 18, n. s., 1908, fasc. 3, p. 331. The type here is the Wolf-Israël *Actinomyces* (according to Sampietro), the species being very similar to the *Streptothrix spitzi* Lignières and Spitz. The author states that he is following Haass.

Actinocladothrix[1]: Affanassiew and Schulz, 1889.

Centralbl. f. Bakt., v. 5. 1889, p. 684. See also Wratsch, No. 2, 1889, p. 24, and St. Petersb. Med. Wochenschr. Jahrg. 13, n. s., v. 5, 1888, pp. 76 and 83. An organism obtained in pure culture from 3 cases of Actinomycosis (2 from pus and 1 from sputum). In bouillon a sediment is formed, consisting of gray-white granules, often coalescing. On blood serum these granules are yellow. The "grains" are 1/10 to 1 mm. in size, consisting of slightly twisted threads, which radiate from the center outward, and divide dichotomically at the periphery. In older cultures undoubted swelling of the threads was observed, but no knoblike enlargements.

Actinocladothrix: Haass (?), 1906.

A. nocardi, Centralbl. f. Bakt., Abt. 1, v. 40. 1906, p. 181. He does not claim the authorship of this species, merely stating that it is synonymous with an Actinomyces isolated by him from the air.

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[1] In a footnote on p. 84 of the earlier reference Affanassiew gives the name *Bacterium actinocladothrix*, but on p 684 of the Cent. f. Bakt., v. 5, 1889, he and Schulz are re- stating at the third Congress of Russian Physicians in Petersburg that "Auf ologischen Eigenschaften schlagen Verfasser vor die Actinomyces als zu bezeichnen."

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Actinomyce: Meyen, 1827.

Linnaea, v. 2, Berlin, 1827, p. 442. Described by Meyen as a fungus. Sporidochia, cellulis hyalinis simplicibus enormiter et multipliciter ramificantibus sporis impletis, substantiae uniformi gelatinosa hyalina induta.

Type species (monotypy).—*Actinomyce horkelii*. R. forma irregulari sphaeroidea, gelatinosa duritie ad basin augente usque ad consistentiam cartilaginosam, colore hyalino-subcoeruleo. Hab. in pinguedine et pleuris animalium aquae submersis, autumno prope Coloniam Agrippinam. Merrill and Wade (The Philip. J. Sci., v. 14, no. 1, Manila, 1919, p. 65) consider that this description "apparently applies to one of the colonial *Cyanophyccae*. * * * The description of both the genus and the species is indisputably valid, and in the present connection the question of its identity is unimportant. In being validly published, it invalidates the further use of the same name for another group of organisms in the plant kingdom."

Actinomyces: Harz, 1877.[1]

Jahresb. d. Kais. Cent. Thierarznei-Schule in München. *In* Zeitschr. f. Thiermed. u. Vergl. Path. Bollinger and Frank, v. 5, Leipzig, 1879, p. 125. Colonies light yellow, roundish, glandular, often united into mulberrylike masses of 1 mm. or more in diameter. Upon slight pressure the spherical colonies break up into numerous, unequal, mostly wedge-shaped segments with rounded ends, 10 to 15 to 50μ in length. At the pointed end of the wedge a conical basal cell is later formed, which bears 2 to 9 or more short-membered hyphae, which give rise in a somewhat irregular manner to a number of duplicating series of dichotomously branched arms. On the branched ends of the homogeneous or finely granular hyphae the short-stalked gonidia are found, single or united into 2 to 3 membered chains. The gonidia are polymorphous, oval, round, or longish club-shaped forms. From these gonidia develop long cylindrical tubes, at the anterior end of which the same process is repeated until the fungus has reached its normal size. See *Actinomyce*.

Type species (monotypy).—*A. boris*, causing actinomycosis in cattle. (Hartz thinks it represents the conidial stage of a fungus.)

Aerobacter: Beijerinck, 1900.

Centralbl. f. Bakt., Abt. 2, v. 6, 1900, p. 197. See also Arch. Néerl. d. Sci. exact. et Nat. Sér. 2, v. 4, 1901, p. 7. Facultative anaerobic organisms which give the "white lead test" with production of sulfides, and certain related ferment organisms. No spores. Very resistant to drying. Ferment dextrose and levulose with production of gas and usually lactic acid. Sulfates not reduced. Nitrates reduced to nitrites, but not to NH_3.

Species.—Bacillus coli commune Escherich. Includes here also *B. liquefaciens* **Tataroff**, and *Bact. lactis aerogenes* Escherich, the latter becoming *Aërobacter aerogenes*.

Aethyl-bacillus: Fitz, 1878.

Ber. d. deutsch. chem. Gesellsch., v. 11, Berlin, 1878, p. 48. 1 pl. A bacillus forming ethyl alcohol from glycerin.

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[1] It should be noted that the majority of investigators have endeavored to divide the group of organisms variously defined as *Actinomyces, Streptothrix, Nocardia, Discomyces*, etc., upon the following characters: Club formation of the filaments found in the granules; granule formation within the tissues; difficulty of cultivation on artificial media; anaerobiosis; presence or absence of arthrospores. Morphological differences seem to have been given but little weight. See *Discomyces*.

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Agonium: Oersted, 1844.

De regionibus marinis, 1844, p. 44. According to Saccardo, Sylloge Fung., v. 8, 1889, p. 938. De Toni and Trevisan included this genus among the Schizomycetes as a "Genus incertae sedis." Filamenta cylindrica, articulata, simplicia, basi ab apice superiore distincta, e puncto centrali commune radiatim exorientia, caespites formantia. Sporae (endosporae) maximae, ovales singulae in unoquoque articulo obvientes. *Type species* (monotypy).—*A. centrale.*

Albococcus:[1] Winslow and Rogers, 1906.

Biological Studies by pupils of W. T. Sedgwick, Boston, June, 1906, pp. 202 and 205. See also J. Inf. Dis, 1906, p. 544, and Systematic Relationships of the Coccaceae, Winslow and Rogers, New York, 1908. Parasites. Cells in groups and short chains (never in packets). Generally stain by Gram. Growth on agar streak abundant and porcelain white in color. Sugars fermented with production of a slight amount of acid. Gelatin liquefaction and nitrate reduction may or may not occur.

Type species (original designation).—*A. pyogenes* [*M. pyogenes* (Rosenbach) Migula]. Also include here *A. rhenanus* (Migula), *A. candicans* (Flügge), and *A. canescens* (Migula).

Amoebobacter: Winogradsky, 1888.

Beitr. z. Morph. u. Phys. der Bact., Leipzig, 1888, Heft 1, p. 71, pl. 3, figs. 1–8. Cells divide in one direction of space, usually round, and united into families by means of plasma threads. Families have amoeboid motion. In the resting state the extruded gelatin becomes stiffened, forming a firm 2-layered membrane. Sulfur granules here and there. Cell masses a delicate rose red.

Type species [subsequent designation by Buchanan (J. Bact. v. 3, No. 5, 1918, p. 469)].—*Amoebobacter roseus* Winogradsky. Cells spherical, 2.8 to 3.4μ in diameter. Winogradsky also includes here *A. bacillosus* (rodlike cells 2 to 4μ long by 1.7μ), and *A. granula* (cells spherical, exceedingly small—scarcely 0.5μ in diameter).

Amoebomonas: Jensen, 1909.

Centralbl. f. Bakt., Abt. 2, v. 22, Jena, 1908–09, pp. 331 and 334. Renames *Amoebobacter* Winogradsky.

Amylobacter: Trécul, 1865.

Compt. rend. Acad. d. sc. Paris, v. 61, 1865, pp. 156 and 432. See also idem v. 65, 1867, p. 513. Under this genus of "amyliferous plantules" he includes 3 types of bacteria: (1) tadpole-shaped group, *Urocephalum;* (2) a cylindrical form, usually attenuated toward one end, *Amylobacter*, and a spindle-shaped form, *Clostridium*. These 3 types he states may be considered as subgenera of his *Amylobacter*. Found in the putrefying cells of various species of flowering plants.

Amylobakter: Schattenfroh and Grassberger, 1899.

Cent. f. Bakt., Abt. 2, v. 5, Jena, 1899, p. 700. Variant of *Amylobacter.*

Aplanobacter: Smith, 1905.

Bacteria in Relation to Plant Diseases, v. 1, Carnegie Instit., Washington, 1905, p. 171. An unattached, nonmotile, rod-shaped organism, without chlorophyll; multiplying by fission; sometimes forming threads of considerable length.

Type species [original designation].—*Bacillus anthracis* Cohn.

[1] This genus has been considered invalid by Winslow, Rothberg, and Parsons (J. Bact., v. 5, No. 2, 1920, p. 161). The type species *A. pyogenes* together with *Staphylococcus epidermidis albus* (Welch) Gordon, and *Albococcus epidermidis* the Winslows, becomes *Staphylococcus epidermidis.*

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Arthrobacillus: Fischer, 1895.

Jahrb. f. wissensch. Bot., v. 27, Berlin, 1895, p. 136. Nonmotile rods with arthrospores.

Arthrobacter: Fischer, 1895.

Jahrb. f. wissensch, Bot., v. 27, Berlin, 1895, p. 141. Nonmotile rods, without flagella, without endospores, with arthrospores.

Fischer (p. 141) states *Arthrobacter* De Bary.

Arthrobacterium: De Bary, 1884.

According to Comp. Morph. and Biol. Fungi, Mycetozoa and Bact., Auth. Eng. rev. trans. by Garnsey, Oxford, 1887, pp. 454 and 468. This genus is proposed for that group of the genus *Bacterium* in which no endogenous spore-formation occurs. "To denote the species which constitute the genus *Bacterium* of authors, I use partly the generic name *Bacillus* * * * and partly the name *Arthrobacterium*. Single members may simply separate from their connections with others, and under suitable conditions become the initial members of new combinations; they have therefore claim to the name spore. In other respects there is no general characteristic distinction between them and the purely vegetative members."

Species.—Bacterium zopfii Kurth, *Bact. merismopoedioides, Bact. aceti*, and *Bact. pastorianum* Hansen.

Arthrobactridium: Fischer, 1895.

Jahrb. f. wissensch. Bot., v. 27, Berlin, 1895, p. 148. Cells straight, rodlike or short ellipsoidal. Division in but one direction. Motile. Arthrospores.

Arthrobactrillum: Fischer, 1895.

Jahrb. f. wissensch. Bot., v. 27, Berlin, 1895, p. 144. Cells straight, rodlike or short ellipsoidal. As for *Bactrillum* Fischer, but with arthrospores.

Arthrobactrinium: Fischer, 1895.

Jahrb. f. wissensch. Bot., v. 27, Berlin, 1895, p. 142. Cells straight, rodlike or short ellipsoidal. Motile. Arthrospores.

Arthrobakterium: Hueppe, 1886.

Die formen der Bakt. Wiesbaden, 1886, p. 145. Variant of *Arthrobacterium*.

Proc. Acad. Nat. Sci., v. 4, Phila., 1850, p. 227. See also A Flora and Fauna within living animals. By Jos. Leidy, Washington, Smithsonian Inst., April, 1853, pp. 33 and 34. Thallus attached by means of one or more granules, simple, cylindrical, very long, filamentous, articulate, without ramuli. Articuli indistinct with amorphous contents finally converted into solitary oval sporuli.

Arthromitus: Leidy, 1850.

Type species (monotypy).—*A. cristatus*.[1] Thallus very delicate, filamentous, linear, straight or inflected, flexible, colorless, translucent, obtusely rounded at the free end. Pedicle of attachment. One or more round or oval amber-colored granules. Articuli indistinct, but becoming well marked after the development of the interior sporular body. Spore oval, simple, faintly yellowish, translucent, highly refractive. Length 1/1500 to 1/12 inch. Breadth about 1/16250 inch. Hab. Parasitic, grows from the mucous membrane of the ventriculus and large intestine of *Julus marginatus, Enterobryus elegans, Ascaris*

[1] Leidy later (p. 35 of v. 5, Proc. Acad. Nat. Sci.), named a second species, *A. nitidus*, but on p. 34 of second mentioned reference he states that *A. cristatus* and *A. nitidus* are identical, the much larger filaments of the latter having confused him.

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infecta, etc. Leidy placed this species among the "Entophyta" allied to the Mycodermata. Buchanan (Meeting of Am. Soc. Bacteriologists, Dec., 1917, Wash., D. C.) placed it under the *Bacillaceae*.

Arthro-Streptokokkus: Hueppe, 1885.

Die Formen d. Bakt. By Ferd. Hueppe, Wiesbaden, 1885, p. 146. A subgenus of *Streptococcus*. "Die vegetativen zellen werden durch Kokkenformen gebildet." No spores. Zoogloeae moderate.

Arthrospirobacterium: This genus has been ascribed to Hueppe. In his "Die Formen d. Bakt.," Wiesbaden, 1885, p. 146, where he classifies the bacteria, he gives as "Gattung" III, Arthro-Spirobakteriaceen. The vegetative cells are screw-like rods. No endogenous spores. Arthrospores. He places *Spirochaeta* as a subgenus of this.

Arthro-Spirobacterium: Klebs, 1887.

Die Allg. Path., Jena, 1887, p. 88. In a résumé of Hueppe's classification, Klebs gives this spelling, and cites the 1881 edition of Hueppe's Die Formen d. Bakt.

Ascobacteria: van Tieghem, 1880.

Bull. Soc. Bot. de France, v. 27, Paris, 1880, p. 151. Colonies small, granular, polyhedral, enveloped in a cartilaginous, thick membrane, and united into larger groups. The contents of each compartment is composed of a great number of little rods, arranged in all directions, and intimately united by a sort of cement. When the colony attains a certain size it breaks into two parts, and the gelatinous membrane prolongs itself between the two surfaces. The single rods from such colonies may start new colonies.

Type species (monotypy).—*A. ulvina*.

Ascobacillus: Edington, 1887.

Brit. Med. J., London, v. 1, 1887, p. 1265, fig. 7. Small rods, 0.8μ long by 0.2μ broad, often dumb-bell shaped, made up of long ovoid spheres. Spores are contained in large sausage-shaped capsules many hundreds times larger than the bacilli themselves. Found in the blood of a patient dying of scarlet fever. De Toni and Trevisan (Saccardo, Sylloge Fungorum, v. 8, 1889, p. 1034) says it is synonymous with *Klebsiella edingtoni* Trevisan.

Ascobacillus: Unna and Tommasoli, 1889.

Monatsh. f. Prakt. Derm. v. 9, 1889, p. 60. Straight or bent bacilli, 1 to 3μ by 0.3μ, single or in twos, grouped or in bundles. Masses taken from agar present the appearance of *Ascococcus billrothii* Cohn. In the interior of these masses the bacilli are nonmotile, but at the periphery a whirling motion may be observed.

Type species (monotypy).—*A. citreus*. Produces a citron yellow color on media. Liquefies gelatin.

Ascobacterium: Babes, 1890 (?).

Cornil et Babes, Les Bactéries, 3 ed., v. 1, 1890, p. 155, fig. 54.

Type species (monotypy).—*A. luteum*. Bacilli straight, 0.4μ by 2 to 3μ long, surrounded by a large oval capsule. The bacilli are found at the periphery of the colonies, in the center of which is a large oblong capsule, almost visible to the naked eye, in which are ovoid masses 10 to 20μ, apparently consisting of agglomerated bacilli. Later the capsule is filled with recognizable bacilli not encapsulated. Finally they become free and are then surrounded by a capsule. Pathogenic; obtained from the air.

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Ascococcos: Billroth, 1874.

Unters. über die Vegetationsformen v. Coccobacteria septica, Berlin, 1874, p. 12, pl. 2, figs. 16–18. Cells small, hyaline, globular, closely united into spherical or oval colonies, surrounded by a thick, gelatinous envelope.

Type species (monotypy).—*A. parvus.* He follows this species name by Aethalium septicum.

Ascococcus: (Billroth) Cohn, 1875.

Beit. z. Biol. d. Pflanz. Cohn. v. I, 1870–75, pp. 151 and 154. Cellulae achromaticae minimae, globosae densissime consociatae in familias tuberculosas globosas vel ovales irregulariter lobatas, lobis in lobulos minores sectis, capsula globosa vel ovali gelatinoso-cartilaginea crassissima circumdatas, in membranam mollem facile secedentem floccosam aggregatas.

Type species (monotypy).—*A. billrothii* Cohn. Familiae tuberculosae 20 to 160μ, capsula ad 15μ crassae. In solutione ammonii tartarici acidi aere lavata sponte ortum, membranam odore lactico vel butyrico praiditam formantem observati Mart. 1874.

Ascococcus: (Cohn) emended Winslow and Rogers, 1905.[1]

Science, n. s. v. 21, 1905, p. 669. See also J. Inf. Dis. v. 3, 1906, p. 485, and the Systematic Relationships of the Coccaceae, Winslow and Rogers, New York, 1908, and The Biological Studies of the Pupils by W. T. Sedgwick, Boston, 1906, p. 151. Generally saprophytic. Grow well on artificial media, producing abundant surface growth. Cells embedded in large, irregularly lobed masses of zoogloeae.

Ascokokkus: Klebs, 1887.

Die Allg. Path., Jena, 1887, p. 343.

A. johnei. Variant of Ascococcus.

Askokokkus: Hueppe, 1885.

Die Formen d. Bakt. Hueppe, Wiesbaden, 1885, p. 148. Variant of *Ascococcus.*

Astasia: Ehrenberg, 1831.

Abhandl. d. König. Akad. d. Wissensch. Berlin, 1831, p. 70. Belongs to the family "Änderlinge" or Astasiaea. Containing chlorophyll. A diatom? *A. euchlora,* etc.

Astasia: Meyer, 1897.[2]

Flora oder Allg. Bot. Zeit., v. 84, Marburg, 1897, p. 185, Pl. VI.

Type species (monotypy).—*A. asterospora.* Found on cooked carrots; 1 to 2 lateral flagella tufts on the normal, one-celled rod. Spores, a motile stage, a resting stage, sporangia. The spores germinate in about 6 hours. From these a very motile rod develops, which passes over into a resting stage, surrounded by a gelatinous membrane. Endospores develop later in these rods, giving them a spindle-shaped appearance. Rarely 2 spores form in one rod. Rods producing spores he calls *sporangia.* A nucleus was stained in all stages.

Asterococcus:[3] Borrel, Dujardin-Beaume, Jeantet, and Juan, 1910.

Ann. de l'Inst. Pasteur, Paris, 1910, p. 168.

Type species (monotypy).—*A. mycoides.* Polymorphic, diplococci, tetracocci, little chains, filaments with swollen ends, asteroids, vibrios, pseudo-vibrios, and

[1] See Buchanan, J. Inf. Dis., v. 17, No. 3, 1915, p. 532.

[2] Buchanan [J. Bact., v. 3, No. 1, 1918, p. 38] makes this a subgenus of *Bacillus.*

[3] Buchanan [J. Bact., v. 3, No. 1, p. 44] places this genus under his new subtribe Hemophilinae.

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forms with multiple polarity. Often the filaments are bifurcate and trifurcate. Nonmotile. The granular forms are often enclosed in a sort of sheath. When the filamentous form first appears it is granular; gradually the granulations disappear and the filaments become phantom-like, ramify, and star-like forms appear. These varied forms were observed under the ultra-microscope, and also by special staining methods. Cause of peripneumonia. The authors state that this genus is "the only filterable virus" which had been obtained in pure culture up to that date. The organism grew only in media containing serum or hemoglobin.

Astrobacter: Jennings, 1896 (1898).

Proc. Roy. Irish Acad. ser. 3, v. 5, Dublin, 1898–1900, p. 312. (Paper was read Dec., 1896.) Diagnosis from stained specimens: Deeply stained starlike bodies composed of a varying number of rays, majority 8 to 10. Y-shaped forms, and also simple rods occur. Author thinks the Y-shaped form due to longitudinal splitting of the rod, as the branches of the fork are always equal, 4-rayed forms with acute and obtuse angles between the pairs of rays are not uncommon, with all transitions to a regular cruciate. In the hexactinellid forms some are irregular, others symmetric as a simple snow-crystal. A central colorless spot observed in a large number of specimens. The bases of the rays are rounded off and project somewhat into this light area, which in some cases communicates with the exterior. Found in stagnant water.

Aurococcus: Winslow and Rogers, 1906.[1]

Biological Studies by the Pupils of W. T. Sedgwick, Boston, June, 1906, pp. 201 and 205. See also Systematic Relationships of the Coccaceae, Winslow and Rogers, New York, 1908. Parasites: Cells in groups and short chains, very rarely in packets. Generally stain by Gram. On agar streak good growth of orange color. Sugars fermented with formation of small amount of acid. Gelatin often liquefied very actively. May or may not reduce nitrates.

Type species (original designation).—*Aurococcus aureus* (Rosenbach).

Azotobacter: Beijerinck, 1901.

Centralbl. f. Bakt., Abt. 2 v. 7, 1901, p. 561. Thick diplococci or short rods 4 to 6μ or less. Sometimes much larger, often with vacuoles and a slimy cell wall. Motile by means of 1 or 4 to 10 polar flagella. No spores. Nonsymbiotically assimilates atmospheric nitrogen. *Hab.*—Soil.

Type species (subsequent designation, Buchanan, J. Bact., 3, No. 1, 1918, p. 47).—*A. chroococcum* Beijerinck. Only very few organisms of young cultures motile, majority nonmotile. Old cultures consist of micrococci of varying size forming sarcina-like packets. Beijerinck also included: *A. agilis* Beijerinck. Actively motile by tufts of polar flagella. Often with transparent cell wall; protoplasm granular, vacuoles.

Azotomonas: Jensen, 1909.

Centralbl. f. Bakt., Abt. 2 v. 22, Jena, 1908–9, p. 328. Polar flagellate bacteria, capable of oxidizing carbon compounds, reducing nitrate to nitrite and in part also further to ammonia. Renames *Azotobacter* Beijerinck.

[1] Buchanan correctly points out that according to the botanical code (article 45) this genus is synonymous with *Staphlycoccus*, and should be abandoned as invalid. Winslow Rothberg, and Parsons (J. Bact., v. 5, No. 2, p. 161, 1920) also conclude that the genus is invalid and agreeing with the Committee Soc. Am. Bact. (J. Bact., v. 2, 1917, and v. 5, 1920) regard the species here designated *Aurococcus aureus* as the type of *Staphylococcus*.

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Babesia: Trevisan, 1889.

Gen. e Spec. delle Batteriaceae, 1889, p. 29. According to de Toni and Trevisan: Saccardo's Sylloge Fung., v. 8, 1889, p. 1054. Cocci ellipsoidei, longitudinaliter binantim seriati (diplococci longitudinales) in filamenta moniliformia, pseudodichotoma nuda (i. e. nec capsulis nec vaginis obducta) concatenati. Arthrosporae macrosomae in apice filamentorum obvenientes. *B. xanthopyretica.* (Syn.) *Streptococcus xanthopyreticus* Trevisan. Filamentis undulato-flexuosis 0.6 to 0.8μ diam., longissimis. Hab. in organis variis in individuis febri flava laborantibus. *B. erysipeloidis* Trevisan.

Babesia: Starcovici, 1893.

Cent. f. Bakt., v. 14, 1893, p. 1. See also Flügge, Die Mikroorganismen, v. 2, 1895, p. 620. Included by Flügge and by Stiles among the Protozoa. Author renames *Haematococcus bovis* Babes and *H. ovis* Babes. Includes here also *Pyrosoma bigeminum*, Th. Smith. Starcovici places his genus between the bacteria and the Protozoa.

Bacillococcus: Frankland, 1890.

Philos. Trans. Roy. Soc. Lond., v. 181, 1890, p. 122, fig. 1. A "bacillus of nitrification" isolated from soil. Rods about 0.8μ long, and almost as broad, coccuslike. Single and in pairs, also in small, irregular groups. Nonmotile.

Bacillopsis: Petschenko, 1908.

Bull. Int. de l'Acad. d. Sci. de Cracovie. Math. et Nat. Cracovie, 1908, p. 359.

Type species (monotypy).—*B. stylopygae.* Found in the digestive tube of *Blatta orientalis* (*Stylopyga orientalis*). Length 10μ, by 2.5μ wide. A slightly curved rod, with one end slightly pointed, the other obtuse. Nucleus is present. Also highly refractive "corpuscules" in the transparent protoplasm, which are probably nutritive substances. Reproduction by a sort of budding, in which the very small daughter cell remains attached to the mother cell by a delicate filament until it has attained the size of mother cell. After this stage of active growth there is a stage in which filiform prolongations appear, and the "corpuscules" unite into 1 or 2, rarely 3 large round bodies. Vacuoles observed. In doubt as to position of organism, but does not think it belongs with the bacteria. (Has been included by other authors among the bacteria.)

Bacillus: Latreille, 1825.

Orthoptera. According to Agassiz: Nomencl. Zool. Index Univ., 1848, p. 122.

Bacillus: Cohn, 1872.[1]

Beitr. z. Biol. d. Pflanz., v. 1, H. 2, Breslau, 1872, p. 174. Straight threads, motile, cylindric, flexible, or rigid; multiplication by transverse division, the individuals often remaining together to form longer or shorter threads or chains. Endospores.

Types species (subsequent designation by many authors).—*B. subtilis* Syn. (Cohn) *Vibrio subtilis* Ehrenberg, and the ferment butyrique of Pasteur. Very thin threads, flexible, delicate; segmentation not readily observed. Single individuals 6μ long, often in pairs, also in threes, and in threads up to 132μ long.

[1] See Stiles (Bull. No. 24. Hyg. Lab. U. S. Treas. Dept., Washington, Sept., 1905, p. 35) who regards *B. subtilis* as the type. Buchanan (J. Bact., v. 3, No. 1, p. 34) gives a very comprehensive review of the characters attributed to the genera *Bacillus* and *Bacterium* by the different authors. He states that the "type of *Bacillus* practically always accepted is *B. subtilis.*"

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No nucleus present. Characteristic motility. "Dauerzellen oder Gonidien" may occur in threads. Includes here also *B. anthracis* (Davaine), and *B. ulna*.

Bacillus: (Cohn) emend. Hueppe, 1886.

Die Formen der Bakterien. F. Hueppe. Wiesbaden, 1886, pp. 142, 148. Rods in straight threads; endogenous spores without enlargement of the cell.

Bacillus: (Cohn) emend. Migula, 1894.

Die Syst. d. Bakt., v. 2, Jena, 1900, p. 515. Shorter or longer, rod-shaped to ovoid straight cells, often united into rather long threads, motile by means of wavy-bent flagella scattered over the whole body. Endospores are frequent. Motility occurs in most species only during a definite period of development.

Bacteriopsis: Trevisan, 1885.

Atti d. Accad. fisio-med.-statis. in Milano, ser. 4, v. 3, 1885, p. 103. Three stages of growth: 1. Bacilli. 2. Filaments. 3. Cocci. The bacilli (typical protoplasmic stage) are short, cylindrical or ellipsoidal, straight, of two forms; macrobacilli and microbacilli. Cytoplasm homogeneous. Filaments (transitory stage) result from division of the bacilli and cocci. The cocci (final stage) are derived from the microbacilli. No spores.

Species.—B. rasmusseni (the Leptothrix I of Rasmussen). Includes here also *Mycoderma aceti* Thomsen, *Bacterium pasteurianum* Hansen, *Micrococcus ureae* Cohn, 1872, *Vibrio synxanthus* Ehrenberg, *Panhistophyton ovatum* Lebert, etc.

Bacteridium: Davaine, 1866.

According to Dict. Encycl. sci. Méd., v. 8, Paris, 1876, pp. 21–28 (paper by Davaine).

In the reprint of this paper in L'Oeuvre de C. J. Davaine, Paris, 1889, p. 425, Davaine gives the date as 1866, but the date appearing on the volume containing the paper as above given is 1876. He published the name "Bactéridie" for the anthrax organism in 1863 (Mém. de Soc. d. Biol., 1863, v. 5, Sér. 3, p. 195). Smith (Bact. in Rel. Plant Dis., v. I, p. 158) gives the date 1868, as do many others. Filiform body, straight or bent, more or less distinctly articulated through imperfect spontaneous division. Not motile. The type species(according to many authors) he describes very fully under this genus description, but names it only in French.

Type species (species first named and studied by Davaine).—*Bactéridic charbonneuse.* Filaments straight, rigid, cylindrical, sometimes composed of 2, 3, rarely 4, segments, when they are inflected at obtuse angles. Very thin compared to their length, which is 0.01 mm. or 0.012 mm. for a single segment, up to 0.05 mm. for a filament. Causing anthrax in man, sheep, cattle, horses, rabbits, etc. He includes several species under this genus, and in one case—the "*Bactéridie du levain*"—he follows with the Latin name *B. fermenti.*

Bacteridium: Schroeter, 1872.

Beitr. z. Biol. d. Pflanz, v. 1, 1875, p. 126. Species: *B. prodigiosum* (Ehrenberg), and several other species of pigment-forming organisms. It is possible that he was following Davaine. Makes no mention of forming a new genus.

NOTE.—*Bactridium* has been ascribed to him by several bacteriologists (e. g., Smith, Bact. in Rel. to Plant Dis., v. 1, 1905, p. 158), but the name he used was *Bacteridium.*

Bacteridium: Sauss. Orthoptera, 1868. Scudder: Nomenclator Zool., Wash., D. C., 1882, p. 35.

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Bacterium: Ehrenberg, 1828.

Symbolae Physicae. Animal. evertebrata. Decas Prima. Hemprich and Ehrenberg, Berlin, 1828, pp. 2 and 8, pl. 2, fig. 6.

Ehrenberg says in Die Infusionstierchen, etc., 1838, p. 57: Gegründet wurde die Gattung *Bacterium* im Jahre 1828 in der Abhandl. d. Berl. Akademie, 1829, p. 15, und in den Symbolae Physicae Hemprich u. Ehrenberg, 1828, mit drei species aus Afrika.

Bacterium, Novum Genus, Familia *Vibrioniorum*. Character Generis: Corpus polygastricum? anenterum? nudum, oblongum, fusiforme aut filiforme, rectum, monomorphum (contractione nunquam dilatatum), parum flexile (nec aperte undatum), transverse in multas partes sponte dividuum.

Type species.—B. triloculare nov. spec.: distincte triloculare s. triarticulatum, subfusiforme, hyalinum. Animalculum 1/200 linie longum, corpore tereti. Articuli s. septa interna divisionem instantem multiplicem transversam indicare bidentur. Mobile sed pigrum animalculum. In Oasi Iovis Hammonis Siwae observatum, praeterea nullibi. Bacterii Generis physiologia hucusque obscura, Cibo colorato ventriculos replere hae formae respuunt ideoque ad Polygastrica non nisi dubitanter et interim collocantur. In 1830 (Abhandl. d. Konig. Akad. d. Wissensch. zu Berlin, 1830–1832, pp. 38 and 69) he adds the following to his earlier description: Phytozoa: Classis I Polygastrica. A. Anentera. Ordo I Nuda. Family I Gymnica. Corpore non ciliato, oreciliato nudove (p. 37). Sectio II Vibrionia. Elongata, in se nunquam contracta. Subsection *c*: Corpore oblongo, fusiformi aut filiformi (tereti aut triquetro nex quadrangulo) aperte undatum non flexili nec spirali: Bacterium. nov. Gen. Haec genera, Oscillatories valde affinia, ore nutriri nondum vidi. He includes eleven species (p. 38) here: *Bacterium cylindric, Bact. deses, Bact. enchelys, Bact. fuscum, Bact. monas, Bact. punctum, Bact. termo, Bact. tremulans, Bact. simplex, Bact. scintillans,* and *Bact. triloculare.*

In Die Infusionsthierchen, p. 74, the genus *Bacterium* is described as follows: Char.: Animal e familia Vibrioniorum, divisione spontanea in catanam filiformem rigidulam abiens.

On p. 74 he also states as to the motlity of the genus: "Ich habe auch bei der stärkesten Art und Gattung *Bacterium* ein Bewegungsorgan als einfachen wirbelnden Rüssel erkant."

For a further characterization see Abhandl. d. König. Akad. d. Wissensch. z. Berlin, 1831–32, pp. 38 and 69, and Die Infusionsthierchen als vollkommene Organismen, Leipzig, Verlag von Leopold Voss, 1838, 548 pp., folio, Pl. V.

Bacterium: (Ehrenberg) emend. Cohn, 1872.

Beit. f. Biol. d. Pflanz., Cohn. v. I Heft 2, Breslau, 1872, pp. 146. 167. Cells short cylindrical or elliptical; Multiplication by cross division. Often in pairs, occasionally in fours. No chains or threads. Zoogloeae.

Type species (inclusion).—*Bact. termo* (Müller, 1773, Ehrenberg, 1830, Dujardin, 1841, Vignal) Cohn. Short cylindrical, oblong cells, with a relatively thick membrane. Measure usually about 1.5μ long, and only half or a third as wide. States that it is the "Ferment der Fäulniss." Motile. *Bact. lineola* (*Vibrio lineola* Ehrenberg ex parte *Vibrio tremulans* Ehrenberg. *Bacterium triloculare* Ehrenberg. *Vibrio lincola* Dujardin. *Vibrio lincola* Müller.)

Bacterium: (Ehrenberg) emend. Migula, 1894. Reference as for *Planococcus;* p. 236. Also Syst. d. Bakt., v. 2, Jena, 1900, p. 279.

Shorter or longer cylindrical cells, sometimes forming threads, without flagella. Endospores.

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Bacterium: (Ehrenberg) emend. Zopf, 1883.

Rods and cocci without spores. Die Spaltpilze. W. Zopf, Breslau, 1883–5.

Bacterium: (Ehrenberg, Cohn) emend. Smith, 1905.

Bacteria in Rel. to Plant Dis., v. 1, Carnegie Institution, Washington, D. C., 1905, p. 171. The one-flagellate, green-fluorescent schizomycetes, capable of growing in Cohn's nutrient solution. To these should be added all the morphologically similar, nonfluorescent and yellow species. Syn. (Smith) *Pseudomonas* Migula. Based on the species *Bacterium termo* Cohn.

Bacterium: (Ehrenberg) emended Jensen, 1909.

Cent. f. Bakt., Abt. 2, v. 22, 1908–9, p. 336. "Wir wollen die artenreiche Gattung der Coli-Bakterien einfach *Bacterium* nennen."

Bacterium: (Ehrenberg, Jensen) emended Winslow, Broadhurst, Buchanan, Krumwiede, Rogers and G. H. Smith, 1917.

J. Bact. v. 2, no. 5, Baltimore, 1917, p. 560. See also Buchanan, J. Bact., v. 3, no. 1, p. 53. Motile or nonmotile rods staining evenly. Easily cultivable. Animal pathogens or saprophytes. Often chromogenic. Many forms actively decompose carbohydrates.

Type species (original designation).—*Bacterium coli* Escherich.

Bacterius: Kendall, 1902.

Public Health Reports and Papers for 1902, v. 28, Columbus, Ohio, 1903, p. 484. See also Proc. Am. Bact. Soc., Chicago, Dec., 1901, Jan., 1902. Cells elongated, cylindrical; longer diameter always greater than the shorter; cells elongated before division; motile, flagellation unknown. (Author states that this group will disappear as knowledge of flagellation becomes more complete.)

Bactrella: Morren, 1830.

Messager des Sciences de Gand, v. 6, 1830. See also Bull. des. Sci. Natur. de Ferussac, v. 27, 1831, p. 203. He places the "Vibrions lamellinaires" in this genus. Corpus simplex, elongatum, cylindricum vel utroque extremo obtusum, vel anticè tenuiter, posticè e contra admodum attenuatum, undique clausum, vel partim, vel omnino mobile. *Species.—B. undula* (*Vibrio undula* Müller). *B. bacillus* (*V. bacillus* Müller). *B. filum* n. sp.

Bactridium: Fischer, A., 1895.

Jahrb. f. wissensch. Bot., v. 27, Berlin, 1895, p. 144. Cells straight, rod-like or short ellipsoidal. Division in but 1 direction. Motile by means of diffuse flagella. Endospores in rods not swollen.

B. subtile (Ehrenberg, Cohn, 1872), *B. megaterium* (De Bary), etc.

Bactridium: Kunze, 1817 (for fungi).
Bactridium: Salisbury, 1839 (section under *Erica*).
Bactridium: Le Conte, 1861 (Zool.).

Bactrillius: Kendall, 1902.

Public Health Reports and Papers for 1902, v. 28, Columbus, Ohio, 1903, p. 484. See also Proc. Am. Bact. Soc., Chicago, Dec., 1901, Jan., 1902. Cells elongated, cylindrical; longer diameter always greater than shorter diameter, cells elongated before division. Monotrichic flagellation.

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Bactrillum: Fischer, A., 1895.

Jahrb. f. wissensch. Bot., v. 27, Berlin, 1895, p. 142. As under *Bactridium* Fischer, but motile by polar flagella. Species: *Bactrillum pseudo-termo* (*Bacterium termo* Aut. pr. p., *Bacterium termo* (Dujardin), Cohn 1872. Cells not cylindrical but clearly ellipsoidal, and usually pointed toward the flagella-bearing end, so that they are somewhat egg-shaped. In pairs often, rarely in chains. No spores. *B. fluorescens longum* (*B. fluorescens longus* Zimmerman).

Bactrinium: Fischer, 1895.

Jahrb. f. wissensch. Bot., v. 27, Berlin, 1895, p. 141. As under *Bactridium* Fischer, except that the cells are motile by means of a single polar flagellum.

Species.—B. pyocyaneus Löffler.

Bactrinius: Kendall, 1902.

Public Health Reports and Papers for 1902, v. 28, Columbus, Ohio, 1903, p. 484. See also Proc. Am. Bact. Soc., Chicago, Dec., 1901, Jan., 1902. Cells elongated, cylindrical, longer diameter always greater than shorter; cells elongated before division; flagellation lophotrophic.

Bakterium: Variant of *Bacterium*. Many German authors.

Beggiatoa: Trevisan, 1842.

Prospetto della Flora Euganea Trevisan. Padova, 1842, p. 56. Thallus e filis muco obvolutis, liberis, oscillantibus, simplicibus, elasticis, rigidis, arachnoides, punctis, asterisciformibus, primum in fascias dispositis dein inordinatis, notatis, conflatus.

Species—*B. leptomitiformis* (Menenghini). B. filis extremitatibus valde attenuatis, subulatis, apicibus acutissimis. *B. punctata* differt filis extremitatibus conformibus, apicibus obtusis. Migula (Syst. d. Bakt., v. 2, 1900, p. 1041) states that this latter species is synonymous with *Beggiatoa alba* (Vaucher) Trevisan. Buchanan (J. Bact., v. 3, No. 5, 1918, p. 464) designates the type as *B. alba* Vaucher, Trevisan.

Betabacterium: Orla-Jensen, 1919.

Mém. de l'Acad. Roy. d. Sci. et d. Lettres de Danemark, Copenhagen, 1919. Sec. d. Sci., 8 me. sér., v. 5, no. 2, pp. 81–196. Lactic acid bacteria. Rods; gram-positive; nonmotile; no spores.

Betacoccus: Orla-Jensen, 1919.

Reference same as above. Lactic acid bacteria. Synonymous (Winslow in Abstracts of Bact., v. 4, 1920, p. 102) with *Leuconostoc* van Tieghem.

Billetia: Trevisan, 1889.

Gen. e Spec. delle Batteriacee, 1889, p. 11. According to De Toni and Trevisan: Sacc. Syllog. Fungorum, v. 8. 1889, p. 931. The genus is here placed under *Kurthia* Trevisan. The type species was *Billetia laminariae* (Billet).

Bollingera: Trevisan, 1889.

Gen. e Spec. delle Batt., 1889, p. 26. According to De Toni and Trevisan, Sacc. Syllog. Fung., v. 8, 1889, p. 1039. Cocci globosi v. divisionis tempore globoso-ovoideis, cystidibus specialibus destituti, numerosissimis, in muco matriceli nidulantes, segregati, in familias globosas, magnas, singulas cystidibus universalibus amplis, crassis, lamellosis, summe firmis, cartilagineis involutas, inordinate consociati. Globae globosae v. ovoideae vel piriformes, omni aetate intus solidae, in acervos permagnos solidissimos, ruborum fructus externam faciem quodammodo simulantes, densissime cumulatae. Coccorum divisio in tres directiones.

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Type species (monotypy).—*B. equi.* Coccis 1 to 1.5μ diameter geminatis vel subbotryoideo congestis. Hab. in pulmonibus equorum morbo "mycodesmoideo" aegrotorum, humani efficit. Syn. (De Toni and Trevisan) *Zoogloea pulmonis equi Bollinger* 1870, *Discomyces equi* Rivolta, *Micrococcus ascoformans* Johne 1885, *M. botryogenes* Rabe, 1886.

Borrelia: Swellengrebel, 1907.

Ann. de l'Inst. Past., v. 21, Paris, 1907, p. 582. Genus is placed under the *Spirillaceae* Migula, and subfamily *Spirochaetaceae* Swellengrebel. Flexible cells with peritrichiate flagella.

Type species (monotypy).—*Sp. gallinarum.*

Botryococcus: Kitt, 1888.

Centralbl. f. Bakt. u. Parasit. Jahrg. 2, v. 3, No. 8, Jena, 1888, p. 246. See also Bacterienk. u. Path. Mikrosk. f. Thierärzte u. Stud. d. Thierm. v. Th. Kitt. 4th Umgearb. Auf., Vienna, 1903, p. 477, 2 figs. Also 5th Aufl., 1908, p. 497. Small granules of the character of micrococci, surrounded by a homogeneous, round or disk-shaped capsule. Single masses of this sort measure 5 to 100μ in diam., and present a glistening, sharp outline. These encapsulated masses may be arranged in botryoidal or grapelike and disklike clusters. The individual cells of these encapsulated bodies measure about 1μ in diam.

Type species (monotypy).—*Botryococcus ascoformans* (Johne, Bollinger). Syn. (Kitt): *Zoogloeae pulmonis equi* Bollinger, 1869; *Discomyces equi* Rivolta; *Botryomyces ascoformans* (Johne) Bollinger, 1887; *Micrococcus botryogenes* Rabe; Micrococcus *ascoformans* Johne. Causing fibrous tumors in horses.

Botrybcoccus: Kützing, 1849.

Spec. Alg. Kützing. Leipzig, 1849, p. 892. An alga in same group with Polycoccus and Palmella, with the type species as *B. braunii.*

Botryomyces: Bollinger, 1887.

Deut. Zeitschr. f. Thierm. u. Vergl. Path., v. 13, Hefts 2 and 3, 1887, p. 176. See also idem., v. 14, 1888–89, and Virchow's Arch., v. 49, 1870, p. 583. Similar macroscopically to *Actinomyces.* Under strong magnification the grapelike colonies consist of conglomerate, roundish, varying-sized broomlike groups or heaps of micrococci (4 to 4.5μ). Each colony (150 to 250μ) is surrounded by a homogeneous capsulelike membrane, and in this respect resembles the *Ascococcus* of Billroth. Ray-funguslike, fibrous masses produced at times in host.

Type species (monotypy).—*B. ascoformans* (Johne). [Bollinger's earlier name was *Zoogloea pulmonis equi.*] Syn. (Bollinger): *Micrococcus botryogenes* Rabe, 1886; *M. ascoformans* Johne, 1885; *Discomyces equi* Rivolta and Micellone, 1879.

Botulobacillus: Jensen, 1909.

Centralbl. f. Bakt., Abt. 2, v. 22, 1908–9, p. 343. Peritrichiate rods, anaerobic, forming an ectotoxin acting on the central nervous system. Includes *Bacillus botulinus* van Ermengem here.

Brachybacterium: Troili-Peterson, 1903.

Centralbl. f. Bakt., Abt. 2 v. 11, 1903–4, p. 138. Short rods, oval or ellipsoidal, whose length does not exceed twice the breadth.

Species.—B. apiculatum n. sp.: Breadth of the short rods 0.8μ, and length sometimes twice the width. Ends usually pointed. Often in pairs, rarely in short chains. Found in Swiss cheese. He also places here *Bacterium lactis acidi* Hueppe, Baumann and *Bact. lactis* Lister, and 6 others which he describes un-

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Butyl-Bacillus: Fitz, 1878.

Ber. d. deutsch. chem. Gesellsch. v. 9, 1878, p. 48. A bacillus forming normal butyl alcohol from glycerin.

Butyribacillus: Jensen, 1909.

Centralbl. f. Bakt., Abt. 2, v. 22, 1908-9,, p. 342. Peritrichiate, spore-forming, obligate anaerobes—the butyric acid group of bacilli.

Species.—Places *Bacillus chauvoei* (Arloing, 1887) here.

Byolysis: Salisbury, 1868.[1]

Microscopic examination of the blood; and vegetations found in variola, vaccinia, and typhoid fever. J. H. Salisbury, N. Y., 1868, 65 pp.

Byolysis typhoides Salisbury.—A minute "algoid vegetation developing in and on the human body in typhoid fever." Flourishes with great luxuriance in the "agminated and solitary glandules of Peyer." The spores multiply by duplicative segmentation, and develop rapidly on and in the cells of the epidermic and mucous surfaces. Spores frequently found in the colorless corpuscules, destroying their contents and dilating their walls, so that the cells are often from 2 to 4 times normal size.

Calymmatobacterium: Beaurefaire-Arago and Vianna, 1913 (=Kalymmabacterium).

Memor. do Instit. Oswaldo Cruz, v. 5, Rio de Janeiro, 1913, p. 221.

Type species (monotypy).—*C. granulomatis.* Encapsulated coccus 0.2 to 0.3μ in diam., or rods with rounded ends of 0.5 to 2μ in length; also encapsulated. Prior to division the rod presents a median constriction, appearing as a diplococcus. Found in granulomata.

Carboxydomonas: Jensen, 1909.

Centralbl. f. Bakt., Abt. 2, v. 22, 1908-9, p. 311. Nonmotile, short rods, capable of oxidizing carbon monoxide.

Type species (monotypy).—*Bacillus oligocarbophilus* Beijerinck and Van Delden.

Carphococcus: Hohl, 1902.

Centralbl. f. Bakt., Abt. 2, v. 9, 1902, p. 338. Variant of *Karphococcus* Hohl.

Carteria: (Musgrave and Clegg, 1908) emended Merrill and Wade, 1919.

The Philippine J. of Sci., v. 14, no. 1, Manila, 1919, p. 64. Corrected spelling of "*Carterii*" Musgrave and Clegg.

Carterii: Musgrave and Clegg, 1908.

The Philip. J. of Sci., v. 3, Med. Sci. B, Manila, 1908, p. 470. Musgrave and Clegg adopt the name *Streptothrix* for the group of branching, filamentous microorganisms known as *Streptothrix*, *Actinomyces* or *Nocardia*, causing a disease in man and animals which they designate "streptothricosis." They state, however: "In making this decision we are fully aware of the rights of those who favor *Actinomyces* or *Nocardia*, and under the circumstances are tempted to introduce a new name (*Carterii*) for the genus, together with a full and complete definition." See *Streptothrix* (Cohn) emended Musgrave and Clegg.

[1] Several of the figures on the plate illustrating this genus resemble streptococci. Salisbury refers to a filamentous stage in this genus only in the figure descriptions where he states that the more mature stage is filamentous. Marchand (Bot. Crypt., t. 1, 1883, p. 471), thinks this genus is synonymous with *Crypta* Salisbury.

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Caryobacterium: Mori, 1913.

Ann. d. Staz. Sperim. per le malattie infettive d. bestiame, v. 1, 1911–1913, p. 302, 1 pl.

Type species (monotypy).—*C. equi.* Causing "Brustseuche" in horses. Cocco-bacillary or bacillary form, either straight or slightly curved; single or united; 2.5μ by 0.5μ; motile. No capsule. A nucleus demonstrated through cultivation on a maltose-mannit-peptone medium, staining by methylene blue, fuchsin, etc.

Caseobacterium: Jensen, 1909.

Cent. f. Bakt., Abt. 2, v. 22, 1908–9, pp. 336 and 337. The lactic acid group of bacteria. Attack casein, but not by means of a proteolytic enzyme; author thinks it may be "ein intracellular oder postmortaler Vorgang."

Cellulobacillus: Jensen, 1909.

Centralbl. f. Bakt., Abt. 2, v. 22, 1908–9, p. 342. Cellulose-fermenting group of peritrichiate rods. Obligate anaerobes.

Type species (monotypy.)—*C. methanigenes.*

Cenomesia: De Toni and Trevisan, 1889.

Saccardo's Sylloge Fungorum, v. 8, 1889, p. 1039. Cocci globosi vel divisionis tempore globoso-ovoidei, modice numerosi, in muco matricali nidulantes, segregati, in familias globosas parvas singulas cystidibus universalibus ampliusculis, crassiusculis homogeneis, nonmalellosis, firmis, gelatinosis involutas, consociati. Familiae e occis ad peripheriam cumulatis compositae, demum intus medio inanes. Cystides speciales nullae. Coccorum divisio, initio generationum serierum, in duas directiones.

Species.—C. albida. Coccis achrois, granulis sulphuris parce onustis. Hab. in consortio Leptotrichiae iveae in aquis sulphuratis pagi "Stabio" Helvetiae Ticinensis (Trevisan). *C. lilacina.* Coccis dilute violaceis, granulis sulphuris abundanter onustis. Hab. in aquis sulphuratis domi cultis (Winogradsky).

Chaos: Linnaeus, 1773–1776.

Vollständiges Natursystem nach der 12 lateinischen Ausgabe und Nach Anleitung des holländischen Houttuni'schen Werks, etc. Nürnberg, 1773–1776. (According to Löffler: Vorles. u. die geschict. Ent. der Lehre von den Bacterien, Leipzig, 1887, p. 9.) Into this one genus Linnaeus placed "die ganze Welt der kleinsten Lebewesen." Ehrenberg (Die Infusionsthierchen 1838, p. 36) says that he separated only "Vorticellen" and a few slightly larger forms, placing all others under his "einfaches," calling them *Chaos infusorium.* Later, he included 5 species under *Chaos: C. fungorum, C. infusorium, C. protheus* [Syn. (Stiles) *Volvox chaos*, a protozoon], *C. redivivum* (a nematode), and *C. ustilago.* Dr. Stiles states in letter of May 23, 1919, that the type is *C. protheus*, synonymous with *Volvox chaos.* Goze (Naturgesch. d. Einigew. 1782, p. 429) used the term for some of the larger infusors. Oken in 1815 (according to Ehrenberg) named *Chaos organicum* "nur noch die Gattung Monas." Bory de St. Vincent (Dict. Class. d' Hist. Nat., 1823) put under this genus "Priestley's green matter"—the green slime of stagnant water, spelling it *Cahos.* Gleichen (Dissertation sur la genération des animalcules spermatique et ceux d'infusoires. Paris, An. VII, 1799, p. 182, 187, etc.) applied this term to "petits globules joints ensemble, se roulant pêle-mêle" and to "parties indiscernibles, se roulant profondement dans l'eau."

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Chatinella: Roze, 1898.

Bull. Soc. Mycol. de France, 14, Paris, 1898, p. 69.

Type species (monotypy).—*C. scissipara*. Saprophyte, found in decayed plant tissues. Spherical bodies, rarely ovoidal, consisting of a colorless protoplasm containing granules, and sometimes what appears to be a nucleus. Not motile. Reproduction by fission. A resting stage observed in which the spherules are surrounded by a membrane reaching a thickness of 3μ. This membrane gradually dissolves when division occurs and the active vegetative stage is reached. The noncapsulated cells measure from 21 to 27μ in diameter. (Roze is not certain as to its position, but thinks it belongs among the Schizomycetes.)

Chlamydatomus: Trevisan, 1879.

Rend. Reale Ist. Lombardo, ser. 2, v. 12, 1879, p. 137. See Saccardo, Sylloge Fungorum 8, 1889, p. 1042, for species. Cellulae globosae, divisionis tempore ovoideae, inordinate in colonias conglobatas pluristratas densisime consociatae, 1 to 4 tegumentis propriis gelatinosis crassiusculis confluentibus obvolutae. Coloniae tegumento communi destitutae.

Species.—C. beigelii. Syn. (Trevisan) *Sclerotium beigelianum* Hallier (Parasitol. Unversuch. p. 75, 1868); *Pleurococcus beigelii* Küchenmeister and Rabenhorst; *C. cellaris* [*Hyalococcus cellaris* (Hansgirg) Schroeter.]

Chlamydothrix: Migula, 1900.

System d. Bakt. Migula. v. 2, Jena, 1900, p. 1030. Cells cylindrical, nonmotile, arranged in unbranched threads surrounded by a sheath of varying thickness. Septation of threads often demonstrable only after the use of reagents. Reproduction by means of round or ovoid, nonmotile conidia, which arise directly from the vegetative cells. Syn. (Migula) *Streptothrix* (Cohn) Migula, *Leptothrix* (Kützing) exp., *Gallionella* Ehrenberg exp.

Type species.—C. ochracea (Kützing). He also places here *C. ferruginea* (Ehrenberg), *C. hyalina* Migula, *C. epiphytica* Migula, *C. fluitans* Migula.

Chlorobacterium: Guillebeau, 1890.

Landw. Jahrb. d. Schweiz, v. 4, 1890, pp. 32 and 41. Rods 3μ by 1μ, very motile. Rapid liquefaction of gelatin. Growth on potato rapid and after 2 days green. Green also on agar-agar. Aerobic and anaerobic.

Type species (monotypy).—*C. lactis* n. sp. Found only once in an inflamed udder.

Chlorobium; Nadson, 1906.

Bul. du Jard. Impér. Bot. de St. Pétersburg, v. 5, 1905, p. 190. Résumé in German, p. 194. See also idem, v. 12, 1912, pp. 55 and 83. A green, chlorophyll containing organism, which author thinks belongs with the bacteria or close to *Stichococcus bacillaris*.

Type species (monotypy).—*C. limicola*. Cocci 0.4 to 0.5μ in diam., round or elliptical, or short rods. Non-motile. Multiplication by cross division. Long chains common in both the round and rod forms. Involution and apochlorotic forms occur.

Chlorochromatium: Lauterborn, 1906.

Allg. bot. Zeitschr., v. 12, No. 12, Karlsruhe, 1906, p. 196. See also idem, vols. 19–20, 1913, p. 98.

Type species (monotypy).—*C. aggregatum* n. g., n. sp. Elliptical to spindle-shaped cells, ends slightly blunt. Color greenish yellow, margins deeper than center. Capsule. Motile. Measures 0.009 to 0.012 mm. by 0.005 to 0.007 mm. Multiplication by transverse fission. These bodies surround mantle-like, an

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axillary colorless, gelatinous (?), "hohlraum." Found in decayed pond weeds. In 1913 Lauterborn places the organism under his newly formed family: Chlorobakteriaceae.

Chloronium: Buder, 1914.

Ber. d. deutsch. Bot. Gesellsch., v. 31, Berlin, 1913–14, Generalvers. Heft, p. (80). Pl. 24.

Type species (monotypy).—*C. mirabile.* Found in water in the Leipzig Botanic Garden. A cylindrical rod 0.7 to 1μ by 1 to 2μ with rounded ends, sometimes slightly curved, green, united into a zoogloeal mass, in the center of which is a colorless, spindle-shaped, 1-polar flagellate organism. The latter measures 2 to 2.5 by 5μ. Multiplication by transverse division. The "peripheral component" is sometimes of coccus form also green of 0.75μ diameter. Usually about 10 to 30 arranged in rather definite order about the colorless central organism. Perfiliev (J. Mic. Biol. v. 1, 1914, p. 223) says that the peripheral forms described here are identical with *Chlorochromatium aggregatum* Lauterborn. Buder is in doubt as to the systematic position of *Chloronium*. Perfiliev describes the "central organism" of Buder's *Chloronium* as *Cylindrogloea*, q. v.

Chondromyces: Berkeley and Curtis, 1857.

Berk. Introd. Crypt. Bot., 1857, p. 313, fig. 70. (Merely named here, no description.) See Grevillea, v. 3, 1874, p. 64. Stipes e floccis compactus ramosus induratus; sporae apicales.

Type species (monotypy).—*C. crocatus* Berkeley and Curtis. On decayed melons. [Car. Inf. 1335.] Stem closely compacted, orange, subcartilaginous, branched, the branches more or less divaricate, nodular at the apex; spores elongate-ovate, with a very short pedicel. Legend beneath figure in first reference states that specimen was from a decayed gourd from South Carolina. Thaxter says it belongs under the *Myxobacteriaceae.* See Bot. Gaz., v. 17, 1892, p. 401, and v. 23, 1897.)

Chromatium: Perty, 1852.

Zur Kenntniss Kleinster Lebensformen. Perty. Bern, 1852, p. 174. Cells small, cylindrical, content granular and colored red, brown, violet or green. "Ein bewegunsfaden am vorderende?" Multiplies by division.

Type species (subsequent designation by Buchanan, J. Bact., v. 3, No. 5, 1918, p. 470, and other authors.).—*C. okenii* (Ehrenberg). Cells with broad, rounded ends, often slightly bent. Includes here also *C. weissii.* Color light violet or brown. Ends rounded, cell granules sharply contoured in older individuals. *C. violascens.* Cells spherical or elliptical, very light violet in color, 1/1200 to 1/900 inch in size.

Chromobacillus: Hansgirg, 1888.

Oesterreich. Bot. Zeitschr., v. 38, 1888, p. 265. Single cells appear almost colorless, the zoogloeae rose to blood red, blue, etc. The only species he discusses here is *B. sanguineus* Schröter, which probably represents the type.

Chromobacterium: (Bergonzini) emended Buchanan, 1918.

J. Bact., v. 3, No. 1, Baltimore, 1918, p. 52. Rod-shaped bacteria with spores; aerobic; producing a violet pigment soluble in alcohol but not in chloroform; motile or nonmotile; gram-staining variable.

Type species (original designation).—*C. violaceum* Bergonzini.

Beggiatoa: Hansgirg, 1888.

Oesterreich Bot. Zietschr., v. 38, 1888, p. 264. A subgenus of *Beggiatoa.* Color rose to cherry red, rose or blue red, or violet to violet brown.

Type species (monotypy).—*Beggiatoa roseopersicina* Zopf.

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Cladochytrium (Nowakowski, 1876) Vuillemin, 1888.

Ann. de la Sci. Agron. Franc. et Etrangère, 2 Ann. v. 1, 1888, p. 1983. A fungus genus belonging to the Chytridinaceae. *C. tuberculorum* Vuillemin. Renames *Schinzia leguminosarum* Frank. Syn. (Buchanan in J. Bact., v. 3, no. 1, 1918, p. 46), *Rhizobium* Frank.

Cladomyces: Engler, 1883.

Vierter Bericht der Commission zur Wissenschaftlichen Untersuchung d. deutschen Meere, in Kiel, 1883, p. 187. Filus gelatinosis juvenculis simplic' us, adultis ramosis ramulis, acutatis apice crescentibus, cellulis subovalibus, egranulosis.

Type species.—C. mobiusii.

Cladothrix: Nuttall, 1849.

Cited by Buchanan in J. Bact., v. 3, no. 3, Baltimore, 1918, p. 302, which use he claims invalidates *Cladothrix* Cohn.

Cladothrix : Cohn, 1873.

Ber. 1. Thätig. d. bot. Sect. d. Schles. Gesellsch., 1873, pp. 42–45. See also Beitr. z. Biol. d. Pflanz., v. 1, Heft 3, Breslau, 1870–1875, pp. 185 and 204. Pl. 5, fig. 8. Filamenta leptotrichoidea tenerrima achroa non articulata vel subundulata pseudodichotoma.

Type species (monotypy).—*C. dichotoma.* Colorless threads. Found in foul water.

Cladothrix: (Cohn) em. De Toni and Trevisan, 1889.

Saccardo's Sylloge Fungorum, v. 8, 1889, p. 927. Filamenta basi ab apice superiore distincta, vagina crassa obducta cylindrica, aetate provecta a basi ad apicem magis magisque incrassata, articulata, pseudoramosa. Arthrosporae binae in singulis microbaculis ellipsoideis ortae.

Clathrococcus: Schmidt and Weis, 1902.

Die Bakterien. Schmidt and Weis. Jena, 1902, pp. 8, 9, 21.

Type species (monotypy).—*C. roseo-persicinus* (Cohn). Belonging to the Sulphur bacteria. A flagellated coccus, cells dividing at first in 3 directions, later only in 2.

Clathrocystis: Henfrey, 1856.

Quart. J. Mic. Sci., London, v. 4, 1856, p. 53. Henfrey described this genus as a yellowish opaque green alga, found in fresh-water pools. Frond a microscopic gelatinous body at first solid, then saccate, ultimately clathrate, composed of a colorless matrix in which are embedded numerous minute gonidia, which multiply by division within the frond, as it increases in size. No zoospores or resting spores observed.

Type species (monotypy).—*C. aeruginosa* (Pl. V, 28–36). Fronds floating in vast strata upon fresh-water pools, forming a bright green scum, finely granular. Gonidia with a distinct membrane, and about 1/8000 inch in diameter. Fully developed fronds 1/50 to 1/15 inch in diameter. Syn. (Henfrey) *Microhaloa aeruginosa* Kützing. Cohn (Ber. u. die That. d. bot. Sec. Schl. Gesell., 1874, p. 36, and Beitr. z. Biol, v. 1, Heft 3, 1875, p. 157) placed a species under Henfrey's genus, e. g., *C. roseo-persicina*, which he states he found on leaves and other plant parts. Cells 2.5μ diameter. First described by Kützing as *Microhaloa rosea* (Linnea, v. 8, p. 341), later by same author as *Protococcus* (Spec. Alg., p. 196), and finally by Rabenhorst as *Pleurococcus roseo-persicinus.* Described (according to Cohn) by Ray Lankester in 1873 (Quart. J. Mic. Sci., v. 13, p. 408) as *Bacterium rubescens.* Migula (Syst. d. Bakt., v. 2, 1900, p. 1043) says Cohn's species is synonymous with *Lamprocystis roseo-persicina* (Kützing) Schröter.

[1] See footnote under *Leptothrix.*

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Clitridium: Billet, 1890.

Bull. Sci. France et Belg., v. 21, sér. 3, v. 3, 1890, p. 54. Bacterium of average length in the form of a biscuit, "c'est-à-dire en train de se segmenter." (Possibly refers to a division stage—merely states the "Clitridium des auteurs," without any further reference.)

Clonothrix[1]: Schorler, 1904.

Centralbl. f. Bakt., Abt. 2, v. 12, 1904, p. 689. One of the iron bacteria closely related to *Crenothrix* and *Cladothrix*. Threads dichotomous or irregularly branched, attached at one end, the free end somewhat thinner. Sheath always present containing either iron oxyhydrate or magnesium oxyhydrate. Cells cylindric to flat discoidal. Multiplication through small, nonmotile conidia of spherical form.

Type species (monotypy).—*Cl. fusca* n. sp. Threads 5 to 7μ thick at base, narrowing off to 2μ at tip. Old segments covered with metal attain a thickness of 24μ. Color varies from colorless to yellow brown and dark brown.

Clostridium: Trécul, 1865.

Compt. rend. Acad. de sci., Paris, v. 61, 1865, p. 435. Describes it as a subgenus under his *Amylobacter*. An "amyliferous plantule," spindle-shaped form. Found in decaying flowering plant cells.

Clostridium: (Trécul) Prazmowski, 1879.

Bot. Zeit., 1879, p. 414. See also Untersuch. über die Entwicklungsgeschichte und Fermentwirkung einiger Bacterien-Arten. Prazmowski, Leipzig, 1880, p. 23. "Um die Synonymik der Bacterien mit einem neuen Worte zu bereichern, habe ich den von Trécul für ein Habitusform des Buttersäureferments zuerst angewendeten Namen *Clostridium* zur Bezeichnung meiner Gattung gewählt."

Species.—*C. butyricum* Prazmowski. Syn. (Prazmowski) *Vibrion septique* of Pasteur; *Amylobacter*, *Clostridium*, *Urocephalum*, Trécul; *B. amylobacter* van Tieghem; *Bact. navicula* Reinke and Berthold. A rod 1 by 3 to 10μ; occurs in threads also; obligatory anaerobe; actively motile; at sporulation the rods swell to a width of 1.8 to 2.6μ; spores 1.2 to 2.5μ in diameter. In solutions of starch, dextrin, sugar (kind not stated) produces hydrogen, carbon dioxide, and much butyric acid. *C. polymyxa* Prazmowski; rodlike cells when young; when older, spindle-shaped, or ellipsoidal, and in those rods showing thickening spores arise, which in size and form are very similar to *C. butyricum*.

Clostrillum: Fischer, 1895.

Jahrb. f. wissensch. Bot., v. 27, Berlin., 1895, p. 144. Cells straight, rod like, or short ellipsoidal. Division in but one direction. Motile by means of tufts of polar flagella. Endospores in spindle-shaped rods.

Clostrinium: Fischer, 1895.

Jahrb. f. wissensch. Bot., v. 27, Berlin, 1895, p. 142. Cells straight, rodlike, or short ellipsoidal. Division in but one direction. Motile by means of a single polar flagellum. Endospores in spindle-shaped rods.

Clostrydium: Migula, 1900 (and others in literature).

Die Syst. d. Bakt. v. 2, 1900, p. 1061. Variant of *Clostridium* (Trécul) Prazmowski.

Coccobacillus: Gamaleïa, 1888.

Cent. f. Bact., v. 4, 1888, p. 167.

Type species (monotypy).—*C. avicidus*. "Huhncholerabakterien." Droplike growth on gelatin, white growth on agar. [Morphology not given.]

[1] See footnote under *Leptothrix*.

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Coccobacteria: Billroth, 1874.

Untersuchungen über die Vegetationsformen von Coccobacteria septica. Berlin, 1874, p. 1, and following.

[NOTE.—Billroth used this name in an inclusive sense, not in a restricted, generic meaning. This is true also of all the names of which he is the author. Apparently he was working with mixed cultures, which represent the various "forms" of his *Coccobacteria septica*.] A sort of plant, which consists in part of cocci, and in part of rod-shaped bacteria, which differ very greatly in size. Both forms are transformed readily one into the other. However, the vegetative form is rather constant, but after a long time the coccos, through stretching and cross constriction, give rise again to the rod-shaped form. In this process of multiplication both vegetative forms secrete a gelatinous sheath (glia); the multiplication occurs first in the upper surface so that thin, membraneous plates of cocci or bacteria arise (*Petalococcos* and *Petalobacteria*); at a certain depth in the liquid, flocculent, cloudy forms of *Gliacoccos* occur. The coccos forms can enlarge greatly and through progressive division give rise again to smaller coccos forms held within a membrane (gliakapsel) which surrounds the whole: *Ascococcos*. In a similar way the bacteria can also give rise to *Ascococcos*. If division is in but one direction and the coccos or bacteria are held together by the gelatinous membrane, then coccos chains (Streptococcos) and bacteria chains (Streptobacteria) are formed. The coccos, streptococcos bacteria, and streptobacteria all show in certain periods of their development (if they are not surrounded by too dense a gelatinous membrane, and are not too large) a sort of sluggish motion.

Cocco-Bacterium: Rivolta, 1887.

L'Allevatore, No. 1, May, 1887. According to Gironale di Anat. Fis. e Pat. degli Animali, Anno 20, Fasc. 1, 1888, p. 3.

Type species (monotypy).—*C. felis*. Motile "cocco bacteria" usually occurring in twos or threes, very closely united. Appear at times almost like micrococci. Vary in length from 0.00142 to 0.00285 mm. Author thinks it is the cause of infectious pleurisy of cats and dogs.

Coccobacterium: Schmidt and Weis, 1902.

Die Bakterien, Schmidt and Weis. Jena, 1902, p. 10. Short, plump rod-shaped cells, only slightly different from *Micrococcus*.

Type species (original designation).—*B. prodigiosus*.

Coccoglia: Billroth, 1874.

See reference under *Coccobacteria*. Throughout this publication Billroth uses this term interchangeably with *Gliacoccos*.

Coccos: Billroth, 1874.

Untersuch. über die Vegetationsformen von *Coccobacteria septica*. Berlin, 1874, p. 4. "The smallest constituent parts of the delicate plants found especially in spoiled liquids." Small, round or oval little bodies. They possess a sort of oscillatory motion scarcely to be distinguished from molecular motion.

Coccothrix: Lutz, 1886.

Dermatol. Studien harausgeg. v. Unna, Heft 1, Hamburg and Leipzig, 1886, p. 98, 1 fig. Small, round, coccus-like cells. Division in but one direction. Single or in series. Capsulated. Sometimes oval and double-contoured. He includes here *B. tuberculosis* Koch, the "lepra bacillus," and *B. malariae* Klebs and Tomassi. On p. 10, Heft 4, 1877, of above citation, Unna gives *Coccothrix leprae* Lutz.

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Coccus: Cohn, 1875.

Beitr. z. Biol. d. Pflanz., v. 1, Heft, 3, Breslau, 1875, p. 147. Changed the spelling of Billroth's "Coccos," using the Latin ending.

Coccus: Used in the generic sense by the following and many others:

C. aquatilis Nissen, 1889. Zeitschr. f. Hyg., v. 6, Leipzig, 1889, p. 487.
C. cumulus minor: Miller, Microorg. d. Mundhöhle, 1892, p. 68.

Coccus: Gotschlich, 1912.

Handbuch d. Path. Org., Kolle and Wasserman, v. 1, 1912, p. 37. Bacteria always spherical.

Cocobacterium: Klinger, 1912.

Centralbl. f. Bakt., Abt. 1, v. 62, 1912, p. 186.

Type species (monotypy).—*C. mucosum anaërobicum.* Found in pus from brain and lung abscesses. Pleomorphic, usually in the form of cocci 0.4μ in diameter. Very frequently in pairs, rarely in chains. After inoculation into another animal often takes the form of rods 1 to 1.5μ in length. On sugar-containing media a much swollen, sausage-shaped or oval form was observed, whose colorless "plasmatische" part lies at one pole; the longer forms have colored points at both ends. These forms vary in size from 0.5 to 1μ to 6μ and over in length. The colorless portion of the cell is rich in glycogen.

Cohnia: Winter, 1884.

Rabenhorst Krypt. Flora, Aufl. 2, v. 1, Pilze, Abt. 1, Leipzig, 1884, pp. 37, 39, 48. Cells roundish, surrounded by a gelatinous sheath, so united as to form a spherical or irregular sack-like mass, which finally becomes net-like. Multiplication by transverse division.

Type species (monotypy).—*Clathrocystis roseo-persicina* Cohn. Syn. (Schröter) *Lamprocystis roseo-persicina* (Cohn) Schröter.

Cohnia: Kunth, 1850.
Cohnia: von Reichenbach, 1852.

Cohnistreptothrix: Pinoy, 1911.

According to Pinoy: Bull. de l'Inst. Past., Paris, 1913, p. 931.

Type species.—Streptothrix israeli Kruse 1896. An aerobe, difficult to cultivate; no arthrospores; grains composed of filaments which fragment irregularly into portions resembling bacilli or micrococci. True branching is found. Pinoy states that the organism was named *Cohnistreptothrix* because of the fact that Cohn first described an organism of the same morphology under the name *Streptothrix foesteri* from lachrymal concretions. He holds, correctly, that *Streptothrix* was unavailable as a name when used by Cohn because of its use in 1839 by Corda for a fungous genus. (For a detailed characterization of this genus see Chalmers and Archibald, New Orl. Med. and Surg. J., v. 70, No. 5, 1917, p. 463, and Ann. Trop. Med. and Parasitol., v. 10, No. 2, 1916, p. 259.)

Cornilia: Trevisan, 1889.

Gen. e spec. delle Batteriacee, 1889, p. 21. According to De Toni and Trevisan: Saccardo's Sylloge Fungorum, v. 8, 1889, p. 998. Baculi plasmate uniformiter diffuso foeti. Sporae (endorsporae) macrosomae, in partibus medianis tumefactis baculorum normalium immutatis exorientes, numquan (in baculis) apicales.

Includes here: *Bacillus alvei* Cheshire and Cheyne; *B. radiatus* Lüderitz; *B. vulgaris* Lüderitz; *B. oedematis-maligni* Hesse; *C. pasteuri* Miquel, etc.

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Corynebacterium: Lehmann and Neumann, 1896.

Atlas und grund. d. Bakt., v. 2, München, 1896. According to Weaver's English translation: Atlas and Principles of Bact., Phila., 1901, pp. 127 and 383. Slender, often somewhat bent rods, often clavate; branches rarely observed in young cultures, easily broken off, and often difficult to find even in old cultures. Not motile. No conidia. Stains interruptedly. Clubbed, wedge-shaped and pointed rods frequent. Not acid fast.

Species.—*C. diphtheriae* (Löffler); *C. mallei* (Löffler and Schütz); *C. pseudodiphtheriticum* (Löffler,. 1887); *C. xerosis* (Neisser and Kuschbert). Buchanan (J. Bact., v. 3, No. 1, 1918, Balto., p. 55) says the type species is *C. diphtheriae*, Lehmann and Neumann.

Corynemonas: Jensen, 1909.

Centralbl. f. Bakt., Abt. 2, v. 22, 1908–9, p. 329. Renames the genus *Corynebacterium* Lehmann and Neumann. "Wegen ihres Sauerstoffbedürfnisses passen sie auch gut an diese Stelle des Systems hinein."

Corynethrix: Czaplewski, 1900.

Deutsche med. Wochnschr., v. 26, Berlin and Leipzig, 1900, p. 720. Bacilli with a tendency toward branching and thread-forming. "Pseudodiphtheriebacillen der Lymphe."

Type species (monotypy).—*C. bovis.*

Crenothrix[1]: Cohn, 1870.

Beitr. z. Biol. d. Pflanz., v. 1, Heft 1, Breslau, 1870–1875, pp. 108 and 130, pl. 6. Trichotoma plus minus stricta arcuata vel contorta in caespitulos libere natantes intricata libera vel alia aliis affixa, in modum Oscillariarum cylindrica elongate filiformia basi tenuissima sursum palluatim incrassata subulata vel subclavata divisione transversa succedanea articulata vaginata hyalina, cellularum plasmate homogeneo intus saepe cavo non granuloso, vagina tenerrima hyalina demum indurata nec non ferro intussuscepto flava. Sporangia terminalia apice trichomatum vagina intumescente elongatoclaviformia, gonidiis subglobosis numerosissimis densissime repleta; gonidia duplicis generis, saepissime in filis diversis formata:

1. Microgonidia, e serie cellularum divisione longitudinali et transversa succedanea multi-partitarum orta, rotundata et diaphragmatibus ruptis in sporangium terminale densissime congesta, demum ex apice vaginae erumpentia, in aqua motu lento circumvoluta secedentia vel in cumulos gelatinosos Zoogloeis consimiles coacervata, ciliis destituta globosa ovalia elliptica transverse plus minus constricta vel divisa, demum in trichomata evoluta.

2. Macrogonida, singula e cellulae contento toto indiviso, vel bi-vel quadripartito orta rotundata, ex apice vaginae vix inflatae erumpentia secedentia, motu forma microgonidiis similia sed majora et minus numerosa, demum germinantia.

Sporae? ex articulo trichomatis terminali elongata aucto formata plasmate denso repleta, quod e vagina erumpere et in trichoma Oscillariae forme evolvi videtur.

Type species (monotypy).—*C. polyspora* n. s., caespitulis minutissimis flavobrunneis in aqua libere natantibus, trichomatibus hyalinis longissimis, 0.0015 to 0.005 mm. crassis, articulis aequi-longis vel duplo longioribus vel dimidio brevioribus, sporangiis subclavatis 0.006 to 0.009 mm. crassis, microgonidiis

[1] See footnote under *Leptothrix.*

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0.001 to 0.002 mm., macrogonidiis ad 0.005 mm. latis, sporis terminalibus ad 0.026 mm. longis. Observ. in aqua puteali.

NOTE.—Cohn described this as an alga, but states that if the lack of chlorophyll places a plant among the fungi, then *Crenothrix* must also be placed among the fungi (l. c. p. 125).

Cristispira: Gross, 1910.

Mitt. aus d. Zool. Stat. zu Neapel, v. 20, Heft 1, Aug. 22, 1910, p. 89. Forms a new family Spironemacea, under which he places this genus and Vuillemin's *Spironema*. A spirally bent flexible body with a crista. Multiplication by transverse division, or "Ausbildung einer Scheidewand, meist mit vorhergehender Incurvation."

C. pectinis n. sp. Average length of mature individuals 72μ; average thickness 1.5μ. Greatest number of spirals, 4. Ends slightly rounded. No appendages. Division with incurvation. Hab. Stomach and intestines of *Pecten jacobaeus*. *C. interrogationis* n. s. Average length 25μ by 0.5μ thick. Greatest number of spirals, 3; ends pointed, often hooked. Division unknown. Hab. Same as above species.

Cromobacterium [1]: Bergonzini, 1880.

Annuario della Soc. dei Natur. in Modena, ser. 2, ann. 14, Modena, 1880, p. 149. Violet microbacteria united into a pellicle. Of form and dimensions very analogous to *Bact. termo*.

Type species (monotypy).—*C. violaceum*. Cellular, cylindrical elements usually single, 2 to 3μ long by 0.6 to 1μ. Oscillatory motion. Colored violet by a substance insoluble in water.

Cromococcus: Bergonzini(?) 1880.

Reference as under Cromobacterium, p. 150.

Type species (monotypy).—*C. violaceus*. Author merely states that this is a micrococcus whose colored zoogloeae are soluble in water.

Crypta: Salisbury, 1868.[2]

The Am. J. Med. Sci., n. s., v. 55, Philadelphia, 1868, p. 19. "Minute, transparent, highly refractive algoid filaments, which develop in living organic matter from spores."

Species.—C. syphilitica n. sp. A homogeneous filament, with extremities obtusely rounded. No transverse markings, except in early stage of development. Filaments either straight, coiled, or arranged in curves. They develop from spores which may be active or inactive in the connective tissue, and may be transplanted from one individual to another. Believed to be the cause of syphilis. *C. gonorrhoeae.*—Spores very minute and well defined. Often in twos and sometimes in fours, undergoing the process of duplicative segmentation. They occur and develop rapidly in and among the parent cells of the mucous surfaces affected. In some instances the pus cells become filled with the spores of this "vegetation." The filamentous stage of this plant is frequently met with in and among the epithelial cells. In their embryonic stages a moniliform arrangement may be seen at times. In later and more advanced stages they are usually homogeneous throughout their entire length. Occur singly or in little knots. Limited in its invasion to the epithelial tissue. Bergonzini (Lo Spallanzani, An. 12, f. 10, Modena, 1884) places these species among the Schizomycetes.

[1] Buchanan (J. Bact., v. 3, No. 1, January, 1918, p. 52) states that Zimmerman in Bot. Cent., v. 4, 1880, p. 1528, corrects the spelling of Cromobacterium to Chromobacterium. the page cited Zimmerman followed the spelling of Bergonzini. Buchanan points out, rectly, that other authors have used *Chromobacterium*.

[2] See footnote under *Zymotosis*.

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Cryptococcus: Freire, 1885.

According to Sternberg: Medical News, v. 52, 1888, p. 452. *C. xanthogenicus.*—Isolated from yellow fever patients, and believed by Freire to be the cause of this disease. Very small cells at first which gradually increase in size, 0.001 mm. to .005 to .008 mm. or more in diameter. When fully mature they break up and discharge their contents, composed of spores mixed with a viscous yellow substance and a black insoluble substance. Resists boiling, retaining its form and motility after such treatment. (Dr. Sternberg says that the liquid cultures Freire gave him were impure, and 1 agar culture was a micrococcus.)

Cryptococcus: Kützing, 1833.

Linnaea, 1833, p. 374. *C. nebulosus.* Globulis achromaticis, diameter 1/1200 to 1/1000‴, in pelliculam, achromaticam tenerrimam laxe ordinatis.

Cylindrogloea: Perfiliev, 1914.

J. Microbiologie (Russ.), v. 1, No. 3–5, Petrograd, 1914, p. 223.

Type species (monotypy).—*C. bactifera.* A bacterium living symbiotically with *Chlorochromatium aggregatum* Lauterborn. A cylindrical, colorless zoogloeal mass, consisting of an axial filament formed by colorless cells, rectangular and numbering 20 to 35, measuring 0.7 to 0.8μ by 2 to 4μ, separated by interstices and surrounded by a mucilaginous envelope. In this outer mucilaginous zone the green bacteria lie, which Perfiliev says react in the same manner as the green form described by Lauterborn. The axial filament is not easily visible, because of the overlying *Chlorochromatium.*

Cystobacter: Schröter, 1886.

Krypt. Flora v. Schles. Cohn, v. 3, Pilze. Breslau, 1885–1889, p. 170. Cells in the form of short, thin rods, embedded in diffuse slimy mass, later united into long threads. The slimy mass divides into irregular roundish clumps which later are surrounded by an almost hornlike structureless envelope. Syn. (Thaxter) *Polyangium* Link.

Species.—*C. fuscus.* Cysts of 30 to 60μ by 20 to 30μ, chestnut brown, suspended in a thin colorless mass, filled with flesh-red contents which contain short, thin rods. *C. erectus.*—The slime masses are flesh red, cylindric-clavate in form, and support clumps up to 80μ high branched, and later surrounded by chestnut brown cyst-membrane.

Deazotonitraazobacterium: Ambroz, 1913.

Centralbl. f. Bakt., Abt. 2, v. 37, 1913, p. 10. Bacteria which set free elementary nitrogen from nitrates. *D. thermophilum* Ambroz.

Deazotonitranitriazobacterium: Ambroz, 1913.

Centralbl. f. Bakt., Abt. 2, v. 37, 1913, p. 10. Bacteria which set free elementary nitrogen from nitrates and nitrites. *D. thermophilum* Ambroz.

Deazotonitriazobacterium: Ambroz, 1913.

Centralbl. f. Bakt., Abt. 2 v. 37, 1913, p. 10. Bacteria which set free elementary nitrogen from nitrites. *D. thermophilum* Ambroz.

Denitrobacillus: Ambroz, 1913.

Centralbl. f. Bakt., Abt. 2, v. 37, 1913, p. 6. Used by Ambroz apparently to designate his *Denitrobacterium thermophilum*, and not with generic distinction.

Denitrobacterium: Jensen, 1909.

Centralbl. f. Bakt., Abt. 2, v. 22, Jena, 1909, pp. 315 and 335. Denitrifying peritrichiate rods. Oxidize ethyl alcohol to carbon dioxide.

Type species (monotypy).—*D. agile* (*Bacillus dentrificans agilis* Ampola and Garino, 1896).

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Denitrobacterium: (Jensen) Ambroz, 1913.

Centralbl. f. Bakt., Abt. 2, v. 37, 1913, p. 3. (Ambroz states that he is following Jensen.) *D. thermophilum*—Rods 3.5 to 7μ long, 1 to 1.8μ broad. Polar spores. Forms a characteristic fluffy white pellicle in the fermentation of nitrate bouillon. Reduces nitrates. According to Harding's classification bears the number 122.4441034. Grows at 70° C. Does not grow below 37° C.

Denitromonas: Jensen, 1909.

Centralbl. f. Bakt., Abt. 2, v. 22, 1909, p. 315. Denitrifying monotrichiate rods. Reduces nitrates to nitrites, then to elementary nitrogen.

Type species (monotypy).—*Bacillus denitrificans* Burri and Stutzer.

Dentalbacterium: Clark, 1879.

Johnston's Dental Miscellony, 1879, p. 447. Half U shaped; 1.5 to 3μ long by 1μ broad. Screw-like motion. Found in the mouth.

Dermacentroxenus: Wolbach, 1919.

J. Med. Research, v. 41, no. 1, Nov., 1919, p. 87.

NOTE.—This organism should probably not be included here, since the author regards it as a new type of parasite. "The reasons for concluding that the parasite of Rocky Mountain spotted fever is not a bacterium, in the ordinary sense of the term, are:

"1. Its morphological sequence in infected nymphs, and the presence of only one morphological type in the blood of mammals.

"2. Its staining reactions and its appearance under dark field illumination.

"3. Its extreme susceptibility to physical and chemical agents.

"4. Its specificity for the peripheral blood vessels, with the production of an identical type of lesion and disease course in all susceptible mammals."

Wolbach's reasons for not including his organism among the protozoa are chiefly lack of definite morphological proof because of the extremely small size of the parasite, and that protozoa are for the most part highly specialized in their host requirements; his spotted fever parasite has a wide range of mammalian hosts.

Three definite morphological types of the spotted fever parasite can be recognized: (1) An extra-nuclear bacillus-like form without chromatoid granules, relatively large and only present in ticks during the initial multiplication of the parasites; (2) a relatively small rod-shaped form with chromatoid granules, probably the same form seen within nuclei in sections of ticks, and rarely in smooth muscle cells in the blood vessels of mammals; and (3) a relatively large lanceolate paired form present in ticks and in the blood and lesions in mammals. This lanceolate form is characterized by its "chromatoid" staining reaction, and according to the evidence at hand is the form in which the virus is passed between the tick and mammalian hosts. The other two forms described are multiplicative stages, and can be demonstrated only occasionally and with difficulty in mammalian hosts. Cultivation experiments unsuccessful. Cause of Rocky Mountain spotted fever.

Type species (monotypy).—*Dermacentroxenus rickettsi.*[1]

[1] Named in honor of Ricketts who first saw it in the blood. Wolbach states that the name "Rickettsia" has been applied by da Rocha-Lima to minute bacillary forms found by Hegler and Prowazek in typhus fever, and regarded as identical with bodies described by Ricketts in Mexican typhus. He thinks that the available descriptions of Ricketts are too meager to permit a trustworthy comparison with the spotted fever [illegible]site, but as Rickett's description of the typhus organism, which he regarded as a [illegible]ium of the plague bacillus group, is markedly different from his description of

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Detoniella: Trevisan, 1889.

According to Saccardo's Sylloge Fungorum, v. 8, 1889, p. 929. Filamenta cylindrica, vagina crassa vel crassiuscula persistente obducta, articulata, simplicia, basi ab apice superiori distincta, propter pulcinulum mucosum primitus affixa immobilia, serius libere natantia, lente oscillantia et in strata varie implexa. Cocci constanter nulli. Multiplicatio baculogonidiis e vagginae apice egredientibus, primitus vivacissime mobilibus, cito immotis. Arthrosporae 4 to 5 in singulis articulis baculiformibus obvenientes.

Includes: *Conferva ochracea* Roth 1797. Syn. (Trevisan) ***Oscillatoria ochracea*** Greville; *Leptothrix ochracea* Kützing.

Dicoccia: Trevisan, 1889.

Gen. e Spec. delle Batteriacee, 1889, p. 26. According to Saccardo's Sylloge Fungorum, v. 8, 1889, p. 1034. Baculi Klebsiellae, capsulis, inclusiplasmate polaridiblastico foeti; sporae, ignotae. Obs. Ut Pasteurella a Bacillo, hoc genus a Klebsiella distat.

Type species (monotypy).—*D. glossophila.* Baculis brevibus, apicibus valde rotundatis, medio leviter constrictis. Hab. in secretione buccali hominis.

Didymohelix: Griffith, 1853.

Ann. and Magaz. of Nat. Hist., ser. 2, v. 12, London, 1853, p. 438. Thinks the true structure of *Gallionella ferruginea* has hitherto been misinterpreted. He therefore places it in a new genus.

Type species (monotypy).—*D. ferruginea* (Ehrenberg). Filaments very minute 1/5000 to 1/30000 inch wide. Each filament consists of two interlacing fibres, forming flattened compound spirals. Fibres are colored by deposits of peroxide of iron.

Diffusionsbacillus: Beijerinck, 1893.

Centralbl. f. Bakt., Abt. 1, v. 14, 1893, p. 830. A species closely related to *B. perlibratus.* Probably did not intend to use it as a generic name.

Diplectridium: Fischer, 1895.

Jahrb. f. wissensch. Bot., v. 27, Berlin, 1895, p. 147. Cells rod like. Division in but one direction; motile by means of diffuse flagella. Cells usually long, cylindrical, with both ends head-shaped, and a spore in each end.

Type species (monotypy).—*B. solmsii* Klein.

Diplobacillus: Weichselbaum, 1887.

Centralbl. f. Bakt., Abt. 1, v. 2, 1887, p. 212.

Type species (monotypy).—*D. brevis endocarditidis.* The cause of ulcerous endocarditis. Short rods with rounded ends, arranged singly or in pairs. Poles usually remain unstained, except in very young individuals.

Diplobacterium: Billet, 1890.

Bull. Scient. de la France et la Belgique, v. 21, ser. 3, Paris, 1890, p. 23. Rectilinear forms of "éléments bactériens" in pairs.

Diplococcos: Billroth, 1874.

Untersuch. ü. die Vegetationsformen v. Coccobacteria septica, Berlin, 1874, p. 16, Pl. I, fig. 4a. Spherical cells in pairs. One of the growth forms of *Coccobacteria septica.*

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the spotted fever organism in blood, the name "Rickettsia" can not be considered as applicable to the spotted fever organism, as described by Wolbach. He concludes that "much more work is required before the classification of 'Rickettsia' and its relation to typhus fever can be arrived at."

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Diplococcus: Weichselbaum, 1886.[1]

Medizin. Jahrb. v. 82, N. Folge 1, 1886, p. 506.

Type species (monotypy and subsequent designation by Buchanan in J. Inf. Dis., v. 17, No. 3, 1915, p. 531).—*D. pneumoniae*. Medium-sized, oval, lancet-shaped, sometimes also round, cocci, which usually occur in twos, rarely in short chains, which are either straight or slightly curved. Capsule present, usually thinner than the diameter of the coccus, but sometimes many times thicker. Zoogloeae. Found in exudate from acute inflammation of the human lung.

Diplococcus: (Weichselbaum) emend. Winslow and Rogers, 1906.[2]

See first reference under *Albococcus*, p. 205. Strict parasistes. Not growing, or very poorly, on artificial media. Cells normally in pairs surrounded by a capsule. Include *D. pneumoniae* Weichselbaum, *D. weichselbaumii* Trevisan, and *D. gonorrhoeae* Neisser.

Type species (subsequent designation by Buchanan in J. Inf. Dis. v. 17, no. 3, 1915, p. 531).—*D. pneumoniae* Weichselbaum.

Diplokokkus: Klebs, 1887. (And other German writers.)

Die Allg. Path. Klebs, Jena, 1887, pp. 321, 326. *D. gonorrhoïcus; D. coryzae.*

Diplopneumococcus: Krokiewicz, 1904.

Weiner Klin. Wochschr., 19.4, No. 20. According to Centralbl. f. Bakt., Abt., 1, v. 36, Ref. p. 561.

Diplostreptococcus: Schütz, 1887 (?).

D. pleuro-pneumoniae.—According to Pfeiler, Zs. f. Immunität., v. 2, 1909, p. 21, and von Lingelsheim: Handbuch d. Path. Mikroorg., Kolle u. Wassermann, ed. 2, v. 4, 1912, p. 494.

Diplovibrio: Billet, 1890.

Bull. Scient. de la France et la Belgique, v. 21, ser. 3, Paris, 1890, p. 28. Vibrios in pairs.

Discomices: (Rivolta) Migula, 1899-1900.

Syst. der Bakt., v. 2, 1899–1900, p. 116. Variant of *Discomyces* Rivolta.

Discomyces: Rivolta, 1878.

Clinica Veterinaria, Nos. 7, 8, and 9, Anno 1, Milano, 1878, pp. 169 and 201. See also Giornale Guglielmo da Saliceto, Piacenza, 1879, No. 5, p. 145, and Giornale di Anat. Fis. e. Patologia degli Animali, v. 16, Pisa, 1884, pp. 195 and 197, and idem v. 14, 1882, p. 20.

Type species.—Actinomyces bovis Harz. Rivolta renames the organism described by Harz as the cause of actinomycosis in cattle, stating that Harz erroneously considered the organism a ray fungus. He thinks the elongated branches, dilated at the free extremity can not be compared to gonidia; propagation occurs simply by means of numerous buds (germogli) produced at the free summit of the branches, which become the primary branches of a new disk (all disks originating from the branches of older disks). He describes the disks as being composed of primary, secondary, and very small tertiary branches, in none of which was any segmentation observed. The tertiary branches are very numerous, of diverse form and length, some having swollen ends, club-shaped or bifurcate, others simply rounded off, with no enlargement. The primary are the older branches which join to a substance which might be

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[1] ...nial combination.

[2] ...c. Am. Bact. (J. Bact., v. 5, no. 3, 1920, p. 206) further emend *Diplococ-* ...nly Gram positive cocci. Fermentative powers high.

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considered as a base. As to his further reasons for changing the name of Harz: "Il complesso od una colonia di corpuscoli discoidi non può in alcun modo essere paragonato alle botriti, al monosporio ed alla polyactis: perocchè queste specie e nel micelio e negli *ifi* e nella produzione di spore offrono tipi caratteristici, che nulla hanno di commune col così dette *Actinomyces bovis*. È vero che i corpuscoli discoidi compressi si risolvono in pennelli od in ventagli [under slight pressure] fatti da rami e ramoscelli, ma percio non si ponno dire *raggiati*. Questa parola in storia naturale ha un senso ben determinato. Il complesso dei dischi che ci rappresenta, se si vuole, un micelio, non ha la forma raggiata, e per conseguenza non si puo denominar raggiato o come venne detto *actinomyces*, e nemmeno si debbono indicare i danni o le lesioni che produce con la parola *actinomicosi*. Il solo nome conveniente, a mio avviso, sarebbe quello di *Discomyces bovis*, e con la parola *sarcomicosi* si potrebbero indicare le lesioni che produce nel corpo del bue" (pp. 207, 208).[1]

Dispora: Kern, 1882.

Biol. Centralbl. v. 2, Leipzig, 1882, p. 135.

Type species (monotypy).—*Dispora caucasica*. Found in symbiotic relationship with *Saccharomyces cerevisiae* Meyer in "kephir" a fermented milk of the Caucasus. The bacteria occur in the clumps of the kephir in a zoogloeal state. Their vegetative cells are 3.2μ to 8μ long by 0.8μ broad. A definite cell membrane present. Polar flagellum. Long Leptothrix-like threads rare. Spores round, measuring 0.8μ to 1μ, and when germinating 1.6μ. In the vegetative state not unlike *B. subtilis* Cohn, from which it differs in its spore formation, i. e., there are always two "endstandige" spores in every cell.

Drepanospora: Petschenko, 1911.

Arch. f. Protistenk. v. 22, 1911, p. 282, 56 figs.

Type species (monotypy).—*D. müllcri* n. g., n. sp. Order Eubacteria, fam. Spirillaceae occupying an intermediate place between *Spirosoma* Migula and *Microspira* Schröter. Cells with 2 spirals, one end pointed, the other somewhat rounded. No cilia or flagella. Helicoidal motion. "Pas de division cellulaire." Endospores. Regular spherical colonies formed by the individuals in certain stages of development. Measure 7μ long by 0.75μ wide. Cell membrane visible on the living cell. In the vegetative state protoplasm composed of an anterior, smaller, strongly refractive part, and a larger posterior or dull part. The anterior portion he considers to be nuclear. Parasitic in bodies of *Paramoecia*.

Drepanospora:[2] Barkeley and Curtis (date?).

According to Engler and Prantl. Die Natürlichen Pflanzenfamilien, Lief. 196 and 197, 1 Teil, 1 abt. Leipzig, 1900, p. 480. A fungus genus belonging to the Hyphomycetes. Type *D. pannosa*.

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[1] For the validity of this genus see Merrill and Wade, The Philippine J. of Sci., v. 14, No. 1, Manila, 1919, p. 55. They correctly state that the name *Discomyces* Rivolta "was practically ignored until Blanchard (1900) argued its priority over Nocardia. Subsequently Gedoelst, Brumpt, Manson, Stitt, and for a time Castellani and Chalmers adopted it." They consider it clearly valid over *Actinomyces* and all subsequent names, but do not argue for its adoption on the strength of Rivolta's reasons for its substitution, which they regard as inconsequential, but because of the earlier use of *Actinomyce* by Meyen. They place the genus among the fungi. These authors continue: "The fact that subsequently Rivolta erroneously referred other organisms to this genus has no bearing on the case. His original application of it was to the organism of Bollinger and Harz alone, which is, therefore, the type of the genus. Nor does the fact that, to propitiate Harz, Rivolta later agreed to accept *Actinomyces* affect the question. As Blanchard pointed out, a name once introduced is no longer the property of its originator to withdraw or modify at will."

[2] Not included in Berkeley's Introducton to Cryptogamic Botany, 1857.

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Eberthella: Buchanan, 1918.

J. Bact., v. 3, No. 1, January, 1918, Balto., p. 53. A subgenus of *Bacterium*. Organisms not showing maximum fermentative power, never producing gas in lactose, frequently pathogenic, never liquefying gelatin, producing gas from none of the carbohydrates. Acid sometimes formed.

Type species (original designation).—*Bacterium* (*Eberthella*) *typhi* Flügge.

Eiterbacterium: Küttner, 1895.

Zeit. f. Hyg. 19, H. 2, p. 263, Syn. (Küttner) *Pyobacterium fischeri* Küttner.

Eitercoccus: Rosenbach, 1884, and many others in literature.

Mikroorganismen bei den Wundinfectionskrankheiten des Menschen. Wiesbaden, 1884, p. 23.

Eiterkettencoccus: Rosenbach, 1884, and many others in literature.

Same reference cited for *Eitercoccus*, p. 26.

Enchelys: Hill, 1752: History of Animals, 1752, p. 2.
Oken, 1815: Lehrb. Naturgeschichte, 1815, 3, 1, p. 36. According to Ehrenberg (Die Infusionsthierchen, etc., 1838, p. 299), *E. bacillus* Oken is syn. with *Vibrio bacillus* Müller.

Endobacterium: Lehmann and Neumann, 1896.

Atlas u. Grund. d. Bakt., v. 2, München, 1896, p. 103. They mention it as an appropriate name for *Bacillus* (Cohn) Hüppe, but do not propose it because of their desire not to introduce a new name.

Endostreptokokkus: Hueppe, 1891.

Die Meth. d. Bakt.-Forschung, Ed. 5, Wiesbaden, 1891, p. 33. Coccus cells united in chains; with endospores; zoogloeae.

Enterococcus: Lewkowicz, 1901.

Przeglad Lekarski, 1901, No. 5–7. According to Lewkowicz's review of this paper in Centralbl. f. Bakt., Abt. 1, v. 29, p. 635. An organism causing epidemic dysentery. Occurs usually as a diplococcus, but also in short chains. Capsulated. No species named.

Enterococcus: Rougentzoff, 1914.

Ann. Inst. Pasteur, v. 28, Paris, 1914, p. 648. *E. saccharomyces*. A nonproteolytic aerobe and facultative anaerobe found in the intestinal tract of rabbits.

NOTE.—The references to this genus in literature usually refer to Thiercelin as the author. In Compt. Ren. Soc. de Biol. Paris, 1899, p. 271, Thiercelin describes a diplostreptococcus causing acute entero-colitis in infants. In its morphology and biology he says it closely approaches the meningococcus. The only name he applies to this species, however, is "enterocoque."

Erebonema: Römer, 1845.

Die Algen Deutschlands, Hannover, 1845, p. 70. Trichomata distincte articulata, laxissime intricata, achromatica, ramosa, inter matricem mucoso-gelatinosam ex globulis mucosis minutissimis compositam nidulantia; articuli cavi, flaccidi, ramulorum ultimi dilatati.

Type species.—*E. hercynicum*, which Schröter (Krypt.-Flora v. Schlesien. Cohn, v. 3, part 1, 1885–1889, p. 152) states is synonymous with his *Leucocystis cellaris*.

Erwinia: Winslow, Broadhurst, Buchanan, Krumwiede, Rogers and Smith, 1917.

J. of Bact., v. 2, No. 5, Sept., 1917, p. 560. Family Bacteriaceae Cohn, 1872, emended. Plant pathogens: Growth usually whitish, often slimy.

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Indol generally not produced. Acid usually formed in certain carbohydrate media, but as a rule no gas. Authors in 1920 (J. Bact., v. 5, no. 3, 1920, p. 209) make the type *E. amylovora* Burrill, 1883.

Erysipelcoccus:

This name has been ascribed by numerous authors to Fehleisen. In Sitz. d. Phys.-Med. Gesellsch. z. Würz., 1881–1885, p. 126 (1881) and p. 9 (1883), he described a micrococcus "der Mikrokokkus des Erysipels." In his second paper he uses in the title of the paper the word "Erysipelkokken," but in the text he uses "mikrokokken."

Erysipelococcus:

See Lipp. Med. Dict., Phila., 1910, p. 322, syn., *Streptococcus erysipelatis.*

Erysipelothrix: Rosenbach, 1909.

Ztschr. f. Hyg., v. 63, 1909, p. 367. See also Verhandl. d. deutsche Gesell. f. Chirurgie. 16th Cong., Berlin, 1887, p. 75. Much like *Cladothrix dichotoma*, but usually much smaller. Roundish, longish bodies, larger than *Staphylococcus*, often in threads, straight or irregularly curved or spiral. Length varies from that of a very short bacillus to one stretching entirely across the field. The threads possess side branches; this does not, however, represent true dichotomy. Some of the threads possess thick points which are probably spores. Not motile.

Species.—*E. porci*, causing "schweinerotlauf," and *E. erysipeloides* (erysipeloid). *E. murisepticus*. Buchanan (J. Bact., v. 3, No. 1, 1918, p. 55) gives the type species as *E. rhusopathiae* Rosenbach (*E. porci*).

Erythroconis: Oersted, 1840–41.

Naturhistorisk Tidskrift, Kroyer, v. 3, 1840–41, p. 555, pl. 7. Massa pulveracea, parum mucosa ex corpusculis quadratis rigidis fragilibus per quaterna aggregatis constans. Genus e familia Diatomearum analogon Palmellae et Tetrasporae.

Type species.—*E. littoralis*, n. sp. Migula says this is synonymous (?) with *Thiopedia rosea* Winogradsky.

Erythrobacillus[2]**:** Fortineau, 1905.

Compt. Rend. de la Soc. de Biol., v. 1, Paris, 1905, p. 104.

Type species (monotypy).—*E. pyosepticus*. A motile "coco-bacille," with no spores; flagella; Gram negative; grows at 37° C., red pigment forms best at 19° to 22° C. Pigment soluble in water, the alcohols, slightly so in chloroform, and insoluble in ether, carbon bisulphide, benzine. Pathogenic for the guinea pig, etc. Isolated from the chemise of a patient at the Hôtel-Dieu, Nantes.[2]

Estaphlycoccus: In Portuguese literature.

Variant of *Staphylococcus.*

Estreptococcus: In Portuguese literature.

Variant of *Streptococcus.*

Eubacillus: Dangeard, 1890–91.[1]

Le Botaniste, ser. 2, 1890–91, Poitiers, p. 151. Vegetative filaments simple, of variable length; hyalin protoplasm, without granulation; chlorophyll diffuse, in very slight quantity throughout the protoplasm. Sporiferous

[1] Several authors have questioned the bacterial nature of the organism described by Dangeard. See Migula, same reference as for *Planococcus*, p. 94.

[2] Committee Soc. Am. Bact. (J. Bact., v. 5, no. 3, 1920, p. 209) amend and change type to *E. prodigiosus* (Ehrenberg) Committee.

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filaments simple or branched; green color more pronounced in swollen parts; spores formed by contraction of the protoplasm of the enlarged portions—this protoplasm abandons its wall little by little, becomes more intensely green and refringent, and surrouns itself with a membrane; spores grouped or isolated.

Type species (monotypy).—*E. multisporus.* Vegetative filaments very long and thin; of delicate green color. Sporiferous filaments also long and inclosing numerous spores, isolated or grouped in twos, threes, or fours, separated by partitions. Spores elliptical and of appreciable green color, containing 1 or 2 refractive granules. Spores 5 to 8μ by 3μ wide. Found in fresh water.

Eubeggiatoa: Hansgirg, 1888.

A subgenus (sect.) of "*Beggiatoa* Oesterr." Bot. Zeitschr. v. 38, 1888, p. 263. Colorless threads, united into chalk-white to gray-yellow slimy masses. Includes *B. alba* (Vaucher) Trevisan. *B. arachnoidea* (Agardh) Rabenhorst.

Eucoccus: Migula, 1895.

Die Natürlichen Pflanzenfamilien, Engler & Prantl. Teil 1, Abt. 1*a* and 1*b*, Leipzig, 1896, Lief. 129, p. 16. Cell content colorless, free of sulfur granules. Later he makes it a subgenus of *Micrococcus.*

Eu-cornilia: Trevisan, 1889.

Gen. e Spec. d. Batt., 1889, p. 21. According to Saccardo's Sylloge Fungorum, v. 8, 1889, p. 998. A subgenus of *Cornilia* Trevisan.

Eucrenothrix: Hansgirg, 1891.

Bot. Zeit., Leipzig, 1891, p. 314. A fresh water plant.

Type species (original designation).—*Crenothrix kühniana* (Rabenhorst) Girad. *C. polyspora* Cohn cum synonymous.

Eu-Klebsiella: (?).

A subgenus of *Klebsiella* Trevisan? The authorship has been given to Trevisan, who used this name for a subtribe only, writing it *Eu-Klebsielleae.* See Saccardo: Sylloge Fungorum, v. 8, 1889, p. 1028.

Eumantegazzaea: De Toni and Trevisan, 1889.

Saccardo's Syllog. Fung., v. 8, 1889, p. 942. A subgenus of *Mantegazzaea* Trevisan. Species achroae, baculis granula sulphuris nulla foventibus.

Eümonas: Diesing, 1850.

Systema Helminthum v. 1, Vindobonae, 1850, p. 22. Subgenus of *Monas* Müller & Ehrenberg. Diesing says *Monas* is synonymous with *Bodo* and *Bacterium* Ehrenberg. *Eümonas:* Animalcula solitaria libera, corpus ecaudatum, subglobosum, ovatum, v. obconicum, hyalinum v. coloratum, haud mutabile, divisione spontanea simplici bipartitum, v. indivisum. Os terminale truncatum, limbo ciliatum v. nudum. Flagellum nudum oscellus nullus. Includes 20 species: *Monas* (*Eümonas*) *crepusculum* Ehrenberg, *M.* (*Eümonas*) *bicolor* Ehrenberg, *M.* (*Eümonas*) *ochracea* Ehrenberg, *M.* (*Eüminas*) *hyalina* Ehrenberg, etc.

Eu-Pacinia: Trevisan, 1889.

Gen. e Spec., d. Batt., 1889, p. 23. From Saccardo's Sylloge Fung., v. 8, 1889, p. 1915. Baculi recti vel rara levisime curvuli interdum in filamenta subrecta consociata. Arthrosporae magnae, quadruplo-octuplo recta vel et ultra diametri transversalis baculorum latiores.

A subgenus of *Pacinia* Trevisan.

Euplanococcus: Migula, 1895.

See reference for *Eucoccus*, p. 19. Cell content colorless, free of sulfur granules.

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Euplanosarcina: Migula, 1895.

See reference for *Eucoccus*, p. 20. Subgenus of *Planosarcina*. Cell content colorless, without sulfur granules.

Eupseudomonas: Migula, 1895.

See reference for *Eucoccus*, p. 29. A subgenus of *Pseudmonas*. Cell content colorless, without sulfur granules.

Eusarcina: Migula, 1895.

See reference for *Eucoccus*, p. 18. A subgenus of *Sarcina*. Cell content colorless, without sulfur granules.

Euspirillum: Migula, 1895.

See reference for *Eucoccus*, p. 33. Cell content colorless. Subgenus of *Spirillum*.

Euspirosoma: Migula, 1900.

System der Bakt. v. 2, Jena, 1900, p. 955. A subgenus of *Spirosoma* Migula. Cells free, i. e., not inclosed in a gelatinous membrane; single or united into a screwlike wound thread.

Fenobacter: Beijerinck, 1900.

Centralbl. f. Bakt., Abt. 2, v. 6, 1900, p. 200. See also Arch. Néerl. ser. 2, v. 4, 1900–1901, p. 9. Aerobic bacteria, closely related to *Aerobacter* Beijerinck. Author states that the "Heupilze" is representative of this group.

Ferribacterium: Brussoff, 1916.

Centralbl. f. Bakt., Abt. 2 v. 45, 1916, p. 547. According to review in Bull. l'Inst. Pasteur, Paris, April, 1917, p. 194.

Type species (monotypy).—*Ferribacterium duplex*. Nonmotile, yellow rodlets, with rounded ends, 2.5 to 5μ, by about half as wide. Usually in pairs, but also single and in short chains. A gelatinous sheath usually present, surrounded by a ferric secretion.

Fusiformis: Hoelling, 1910.

Arch. f. Protistenk., v. 19, Jena, 1910, p. 240, 1 pl. Spindle-shaped organisms containing demonstrable nuclei [Haidenhain (E–H), and Romanowsky-Schilling methods].

Type species (subsequent designation by Committee in J. Bact., v. 2, 1917, p. 555).—*F. termitidis* Hoelling. Hoelling is probably renaming here *Bacillus fusiformus*. Also mentions *Fusiformis muris* and *F. dentium*.

Gaffkya: Trevisan, 1885.

Atti. d. Accad. fisio-med.-statis. in Milano, 4 ser., v. 3, 1885, p. 106. Cocci in colonies of 4, globose, surrounded by a hyaline capsule, finally free.

Type species (monotypy).—*G. tetragena*. Syn. *Micrococcus tetragenus* Gaffky.

Gaillonella:[1] Bory de St. Vincent, 1823.

Dict. classique d'Hist. Nat., v. 4, 1823, p. 393. See also idem, v. 7, 1825, p. 101. Simple cylindrical filaments, articulated, each section including two capsulary corpuscles, spheroidal, transparent, even when filled with ferruginous coloring matter, and divided into two equal parts by a "dissépiment" which appears as a line. "Nous n'hésitons pas à regarder les Gaillonelles comme de simples végétaux."

Type species (original designation).—*Conferva moniliformis* Müller. Places *C. nummuloides* here also.

[1] This genus is included following Ellis (Cent. f. Bakt., Abt. 2, v. 19, 1907, p. 505).

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Galactobacterium: Guillebeau, 1890.

Land. Jahrb. d. Schweiz, v. 4, 1890, p. 43. Occurring sporadically in inflamed udders. No description.

Galactococcus: Guillebeau, 1890.

Landw. Jahrb. d. Schweiz, v. 4, 1890, p. 32.

Species.—*G. versicolor* n. sp. Cocci of about 1μ diameter. Nonmotile. Gram positive. Long chains in milk, which is rapidly acidified. Aerobe. Belongs to the "häufigeren Mastitispilzen." *G. fulvus* n. sp. Cocci of not more than 1μ diameter. Nonmotile. Gram positive. Ochre-yellow on potato. *G. albus* n. sp. Cocci about 1μ diameter. Nonmotile. Gram positive. White colonies on milk gelatin, which is not at all or only slightly liquefied. Dirty white growth on potato. All of these species found in milk from an inflamed udder.

Gallionella: (Bory de St. Vincent) Ehrenberg, 1836.

Variant of *Gaillonella* Bory de St. Vincent. Abhandl. König. Akad. d. Wissensch. z. Berlin, 1836, pp. 52 and 84. See also Poggendorf's Ann. d. Physik. u. Chem. 2, v. 8, 1836, p. 217, and Die Infusionsthierchen, 1838, pp. 166 and 169. *G. ferruginea*. Corpusculis, tenuissimis, utrinque convexis, ovatis, glabris, ferrugineis, filis articulatis, saepe, conglutanis, subramosis. Found in iron waters. Includes several other species. See Ellis: Centralbl. f. Bakt., Abt. 2, v. 19, 1907, p. 505.

Gallionella: (Ehrenberg) em. Ellis, 1907.

Cent. f. Bakt., Abt. 2, v. 19, Jena, 1907, p. 505. Ellis places this genus among the thread bacteria (see footnote under *Leptothrix*). Long cylindrical thread, bent first in the form of a hairpin, then spirally around itself. Ends rounded off in the same way as those of bacillus cells. The spiral winding produces a number of loops which may be few or many according to the age and condition of the individual. Average thickness of thread is 0.5μ to 0.75μ, but may attain 1.5μ in diameter. Great disparity of size in same culture. Sometimes threads not wound. Migula's membrane not demonstrated. Multiplication by cell division [as shown by Migula], and by conidia formation. Conidia of same size and shape as those in *Leptothrix ochracea* and *Spirophyllum ferruginea* Ellis. Threads nonmotile and contain large deposits of ferric hydroxide.

Gleobacter: Fischer, 1895.

Jahrb. f. wissensch. Bot., v. 27, Berlin, 1895, p. 135. Rod bacteria, capsulated. Syn. (Fischer) *Klebsiella* Trevisan.

Gloeosphaera: Rabenhorst, 1854. An algal genus.

Algen Mitteleuropas n. 387. Hedwigia, v. 1, Dresden, 1854, p. 43, pl. 8, fig. 2. Species: *G. ferruginea* (Kützing). Syn. (Ellis) *Gallionella ferruginea* Ehrenberg.

Gliabacteria: Billroth, 1874.

Untersuch. u. die Veg. v. Coccobacteria septica, Berlin, 1874, p. 15. Rod forms which arise from the "dauersporen" or *Gliacoccos*, and are surrounded by a gelatinous substance which unites them into greater or less groups. Nonmotile at first, later motile, especially along the periphery of the colonies. See *Coccobacteria*.

Gliacoccos: Billroth, 1874.

Reference as for *Gliabacteria*, pp. 5 and 6, Pl. I. Cocci growing on the upper surface of liquids which surround themselves with a gelatinous membrane forming irregular heaps and balls. See *Coccobacteria*.

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Gliacoccus: Maggi, 1886.

According to Winslow, Broadhurst, Buchanan et al. J. Bact. v. 2, No. 5, Baltimore, 1917, p. 551. Syn. (?) with *Mycoderma* Persoon.

Glia-Kokkus: Klebs, 1887.

Die Allg. Path., Jena, 1887, p. 310. Variant of *Gliacoccos*.

Glischrobacterium: Malerba and Sanna-Salaris, 1888.

Rend. d. Accad. d. Sci. Fis. e Mat., Ser. 2, v. 2, Anno 27, Fasc. 6, 12, Napoli, 1888, pp. 196 and 495. See also Archiv. ital. de Biol. v. 10, Fasc. 2, 3, p. 358. The cause of viscid and thready urine. A somewhat elongated micrococcus, 1.14 to 0.57μ long by 0.41μ wide. In beef bouillon it is a very short bacillus, with a weak rotatory motion. Single or in twos or long chains. In gelatin cultures bubbles of gas are formed more or less completely surrounded by a "glischrogenic" substance.

Gloeotila: Kützing, 1843.

Phyc. gener. Leipzig, p. 245. Defined here as an alga. *G. ferruginea* Kützing is syn (?) with *Gallionella ferruginea* Ehrenberg.

Glöokokkus: Klebs, 1887.

Die Allg. Path., Jena, 1887, p. 329. Changed spelling of Billroth's *Gliacoccos*.

Gonium: Ehrenberg, 1828.

Symbolae Phys., 1828, p. 34. See also Abhandl. König. Akad. d. Wiss. z. Berl., 1830 (1832). Schröter (Krypt.-Flora v. Schlesien. Cohn. v. 3, Part 1, 1885–89, p. 151) says *Gonium hyalina* is syn. with *Lampropedia hyalina*, and *Merismopedia hyalina* Kützing.

Gonococcus: Migula, 1895.

Die natürl. Pflanzenf. Engler & Prantl. Teil 1, Abt. 1*a*, Lief. 129, Leipzig, 1896, p. 16. Migula gives: *Micrococcus gonorrhoeae* (Neisser) Flügge (=*Gonococcus gonorrhoeae* Neisser). Lindau (Just's Bot. Jahrb. v. 26, 1898, pp. 100 and 101) also uses the name generically: *G. neisseri*. Also Paldrock (Derm. Centralbl. v. 7, Leipzig, 1905, p. 322). It is used in the generic sense in the indices and by reviewers in the Centralbl. f. Bakt., Abt. 1 (v. 27, 1900, p. 893, v. 24, 1898, p. 1006, etc.). The organism referred to in these references is undoubtedly that discovered by Neisser, but in none of his publications did he use the name in the generic sense. His first paper is in the Cent. f. medizin. Wissensch. v. 17, 1879, No. 28, p. 497, where he describes the organism in detail. In some of his later papers (e. g., Deut. med. Woch. No. 20, May 13, 1882) he uses the term "gonokokken."

Granulobacillus: Schattenfroh and Grassberger, 1899.

Centralbl. f. Bakt., Abt. 2, v. 5, Jena, 1899, p. 702. Genus differs from *Granulobacter* Beijerinck in that it includes both nonmotile and motile forms.

G. saccharobutyricus immobilis liquefaciens.—Nonmotile liquefying gelatin. Spores formed only on highly alkaline media, and they are of many sizes and forms, and placed differently within the rods. Hiss and Zinsser [Textbook of Bact., Ed. 4, N. Y., 1918, p. 472] state that this species is probably identical with *Bacillus aërogenes capsulatus* Welch and Nuttall, 1892.

G. saccharobutyricus mobilis nonliquefaciens.—Motile, not liquefying gelatin. Says the "Buttersäurebacillus I" of Gruber belongs here, also *B. saccharobutyricus* Klecki, and *Granulobakter saccharobutyricum* Beijerinck.

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Granulobacter: Beijerinck, 1893.

Verhandl. d. Koniklijke Akad. v. Wetensch., Deel I, No. 10, 1893, p. 3. "Butyl ferment organisms." Obligatory or facultative anaerobic. Become filled with granules and assume a clostridium form. In the presence of oxygen motile rods result. Always CO_2 and usually hydrogen as a result of fermentation.

Species.—*G. butylicum.* Syn. (Beijerinck) *B. amylobacter* (van Tieghem, 1877) Gruber. *Granulobacter saccharobutyricum.* Syn. (Beijerinck) *Bacillus butylicus Fitz, G. polymyxa* (Prazmowski), etc.

Granulobakter: Schattenfroh and Grassberger, 1899.

Centralbl. f. Bakt., Abt. 2, v. 5, Jena, 1899, p. 702. Variant of *Granulobacter* Beijerinck.

Grippestreptokokkus: Seligman, 1911.

Centralbl. f. Bakt., Abt. 1 Ref., v. 50, 1911, pp. 81–83. An organism which he states to be a new species of *Streptococcus.* Single, in pairs and chains.

Gyrococcus: Glaser and Chapman, 1912.

Science, n. s., v. 36, No. 920, 1912, p. 223.

Type species (monotypy).—*G. flaccidifex gen. et spec. nov.* Cells in free state spherical, becoming slightly oblong just before division. Division in 1 direction only. After division each half may be spherical or may come to an abroupt tip, assuming a more or less heart-shaped appearance. Frequently the two halves are unequal; one-half may be spherical while the other may be more or less heart-shaped, or slightly oblong. If cells remain connected after fission, chains of 3 or 4 are formed. Diameter of cells 0.51μ to 0.85μ. No endospores. Capsule distinct. Motile—progressing in a gyrating manner, but no flagella were stained. Gram negative. Very closely resembles the Pneumococcus, except that it is Gram negative, and motile. Cause of wilt disease or "flacheria" of the gypsy moth.

Haematococcus: Agardh, 1828.

Icones Algarum Europaearum, Leipzig, 1828, pp. 45–50.

H. noltii.—Globulis elliptico-sphaericis sanguineis includentibus granulo conferta numerosa. In stagnis turfosis siesvici tempore verno.

H. grevillii.—Globulis exacte sphaericis minutissimis viride purpureis includentibus granula subdena.

H. sanguineus.—Globulis ellipticis minutis pellucidis includentibus granula pauca rosea laxe disposita.

Haematococcus: Babes, 1889.

Virchow's Arch., 115, Folge XI, v. V, 1889, p. 106. See also Compt. Rend. de l'Acad. d. Sci. de Paris, v. 110, 1890, pp. 800 and 975; Centralbl. f. Bact., Abt. 1, v. 33, 1902, p. 456, and Ann. de l'Inst. de Bact. Bukarest, 1888–89.

H. bovis.—Biscuit-shaped cocci united in pairs, sometimes oblong in form. Isolated or in groups. The single cocci are surrounded by a pale yellowish halo. Syn. (Migula, Syst. d. Bakt., v. 2, 1900, p. 85) *Micrococcus bovis* (Babes) Migula. Flügge (Die Mikroorganismen, v. 2, 1896, p. 620) says this species is synonymous with *Babesia bovis* Starcovici. Cause of hemoglobinuria in cattle.

Haematokokkus: Eisenberg, 1891.

Bakt. Diagnostik, Hamburg, 1891, p. 271. Variant of *Haematococcus.*

[B]acterium: Fischer, 1894.

Bakterien des Meeres. Fischer, B., Leipzig, 1894, 82 pp. Of varying form and size, but usually comma-like or S-shaped. Spherical form found in sea water. The majority of these organisms require a

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rather high salt content in their media: To 5 c.c. of the usual nutrient agar, 2 c.c. of ocean water with a salt content of 3.5 per cent were added. Some of them grow very feebly and others not at all *(H. polymorphum)* on media containing the usual amount of salt; those which do show feeble growth on the usual gelatin or agar give none of their characteristic reactions on such media. The most satisfactory media were those made by using sea water, to which was added the proper amount of nutrient agar or gelatin.

Type species (first in order or arrangement in text).—*H. pellucidum.* Small to medium rods, almost coccus-like, single, in 2's, or short chains of not more than 4 or 6. Often in zoogloeal masses. Somewhat longer, spindle-shaped rods also observed, as well as comma-like and S-shaped forms, and straight or curved inarticulate short threads which are sometimes irregularly wound, screw-like. Usually actively motile. On gelatin the colonies are round, gray, transparent, drop-like. Gelatin not liquefied. Includes here *H. roseum, H. rubrofuscum, H. polymorphum, H. liquefaciens.*

Helicobacterium: Miller, 1886.

Deut. med. Wchenschr., Berlin, 1886, p. 117. See also Miller's Wörterbuch d. Bacterienkunde, Stuttgart, 1886, p. 18.

H. aerogenes (Escherich) Miller.—Thin, motile rods, single or in chains, growing into long, wavy, bent threads, which may form spirals. Found in the human stomach.

H. klebsii (Escherich).—Cocci, rods, threads, etc., forming snake-like colonies, and of manifold forms. Found in guinea pig intestine.

Helicomonaden: Klebs, 1879.

Archiv. f. Exp. Path. u. Pharm., v. 10, 1879, pp. 161–218, 2 pls. A pleomorphic organism, consisting at times of short rods, arranged in more or less spiral form, and of granules; motile. The granules arise from the rods, which toward the end of a spiral series become shorter and shorter, finally appearing as small round bodies. As to their being micrococci he says "Die Möglichkeit dass dem so sei, lässt sich nicht ableugnen, doch wird es in diesem Falle nicht an der Auffindung weiterer Differenzen fehlen, welche uns gestatten werden, ein kürzestes Stäbchen, ein Brachbactron etwa, von einem Coccus zu unterscheiden." He thinks no spores are formed, and that longitudinal division occurs. The granules (körnchen) also form spiral-like masses. The rod form in culture forms "Bakterienballen." The cause of syphilis.

Helicomonas:

The name *Helicomonas syphiliticum* for the organism Klebs describes as above has been ascribed to Klebs, but in none of his publications have I found it. This name occurs in many German papers on this subject, and in Lipp. Med. Dict., Philadelphia, 1910, p. 411.

Helikobacterium: Escherich, 1886.

Münch. med. Woch., 1886, v. 33, p. 2. Characterized by its spiral colonies on gelatin plates. As the gelatin liquefies zoogloeae of spindle-shape are formed, which anastomose, covering the entire surface of the gelatin, and consisting of "swarming" bacteria, spirilla, and watch-spring-like threads. In older gelatin cultures round and elliptical forms in varied grouping are found (diplococci, tetrads, chains, etc.). He figures what he describes as "spirochäten" occurring in a milk culture of his *Helikobacterium.*

Species.—Thinks *Bacterium zopfii* Kurth belongs here and suggests the name *H. zopfii* for it. In one paragraph he writes his genus *Helikobacterium* (Klebs), probably referring to *Helicomonaden* Klebs.

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Helikomonas: Escherich, 1886.

Münch. med. Woch., 1886, p. 2. *H. syphiliticum.* Variant of *Helicomonas.*

Helobacteria: Billroth, 1784.

Untersuchungen ü. die Vegetationsformen v. Coccobacteria Septica, Berlin, 1874, pp. 22, 23, Pl. IV. "Nail-like" bacteria. At one end of the rod is a highly refractive body which he concludes is a spore, the diameter of the spore greatly exceeding that of the rod.

Hemophilus: Winslow, Broadhurst, Buchanan et al, 1917.

J. Bact., v. 2, No. 5, Sept., 1917, p. 561. Family Bacteriaceae Cohn 1872 emended. Minute rod-shaped cells, nonmotile, without spores; strict parasites, growing best (or only) in the presence of hemoglobin, and in general requiring blood serum or ascitic fluid. Gram negative.

Type species (original designation).—*H. influenzae* (Pfeiffer), comb. nov.

Hillhousia: West and Griffiths, 1909.

Proc. Roy. Soc. Lond., Ser. B, Biol. Sci., v. 81, 1909, p. 398.

Type species (monotypy).—*H. mirabilis.* A sulfur bacterium of giant proportions—"the largest solitary bacterium which has so far been discovered." Average length about 60μ, and breadth about 26μ. Peritrichiate. Each individual contains a protoplasmic network in the wide meshes of which large globules of sulfur are located. The network includes numerous small granules, a considerable proportion of which consist of some nucleo-proteid (linin?). None of them are chromatin granules. Cell wall is firm and very resistant to reagents. Not homogeneous, and 5 per cent phenol demonstrates its lamellose character. Multiplication relatively slow, one division occupying about 24 hours. Transverse fission. Habitat: Stagnant pools and marshy bogs.

Hyalococcus: Schröter, 1886.

Krypt.-Flora v. Schlesien. Cohn. v. 3, pt. 1, Pilze. Breslau, 1885–1889, p. 152. Cells spherical or elliptical; single or in twos, rarely in series of 4 and 6. Capsule, sharply defined.

H. pneumoniae.—Syn. (Schröter) *Pneumococcus,* Friedlander 1882. Cells spherical or elliptical. Single or in two or more. Capsule rare in culture, but always present on organism from lung exudate.

H. beigelii (Küchenmeister and Rabenhorst).—Syn. (Schröter) *Pleurococcus beigelii* Küchenmeister and Rabenhorst 1867. Cells spherical with a mucilaginous capsule 3 to 4μ in diameter. Found on living hair, and hair cut from the heads of healthy persons.

Hydrogenomonas: Jensen, 1909.

Centralbl. f. Bakt., Abt. 2, v. 22, Jena, 1909, p. 311. Monotrichiate short rods, oxidizing hydrogen to water.

Type species (monotypy).—*Baccillus pantotrophus* Kaserer.

Hygrocrocis: Agardh, 1843.

Linneae, 1843, p. 82. An algal genus into which some species of bacteria were erroneously placed, e. g., *H. vandellii* Menenghini Syn. (Migula, Syst. d. Bakt., 2, 1900, p. 1041) *Beggiatoa alba* (Vaucher) Trevisan.

Hypnococcus: Bettencourt, Kopke, et al, 1904.

Revista Port. de Med. e Clr. Prat., v. 12, 1902, p. 291–299. See also Centralbl. f. Bakt., Abt. 1, v. 35, 1904, p. 45. In the earlier publication the organism is described as a "diplostreptococcus" and called "hypnococco." In 1904 they use the name *Hypnococcus:* A diplococcus, the ele- rounded, sometimes one of the diameters slightly larger than the elliptical; arranged opposite each other much as the gonococcus.

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Chains of 2, 3, 4, or more. The individual cells measure 0.7 to 0.8μ. Always nonmotile.

Hyphomicrobium: Stutzer and Hartleb, 1901.
Mitt. d. Land. Inst. Breslau, v. 1, Berlin, 1901, p. 76 and 107.
Type species (monotypy).—*H. vulgare.* A nitrifying (?) organism found in soil. Related to the bacteria and to the hyphomycetes. On nitrate agar, small homogeneous rods, with usually pointed ends, 0.6 to 0.8μ by 1 to 1.5μ long. Stained with phenol fuchsin a darker central body surrounded by a clear zone may be observed. Egg-shaped forms in older cultures, which send out threads, some of which show true branching. Multiplication also by transverse division. Found also in cement which they think was decomposing through the assistance of this organism.

Indiellopsis: Brumpt, 1913.
According to Chalmers and Christopherson: Ann. Trop. Med. and Parasitol., Liverpool, 1915, pp. 240–255. Brumpt classified the cause of certain mycetomas of the hand as *Indiella somaliensis* (1906). In 1913 he renamed this species *Discomyces somaliensis*, and in the same year created a new genus or subgenus for it: *Indiellopsis somaliensis.* Chalmers and Christopherson change its name to *Nocardia somaliensis* (Brumpt, 1906). Brumpt based his *Indiellopsis* on the fact that the species secreted around itself in the grain a hard sheath, insoluble in potash and eau de javelle, which no other *Nocardia* is known to do.

Indolococcus: Jensen, 1909.
Centralbl. f. Bakt., Abt. 2, v. 22, Jena, 1909, p. 340. A coccus characterized by indol production.

Iodococcus:
Variant of *Jodococcus* Miller.

Iodococcus:
Lipp. Med. Dict., Phila., 1910, p. 452. "A minute bacterial coccus found in the mouth, which gives a blue color with iodine."

Jodococcus: Miller, 1888.
Deut. med. Wchenschr., 1888, No. 30, p. 612. See also Die Mikroorg. der Mundhöhle, 1889, p. 60.
J. magnus.—Large cocci, in pairs, of varying size. Staining blue to violet with iodine. Does not grow on the ordinary media.
J. parvus.—A smaller micrococcus, giving the same color reactions with iodine.

Kakkecoccus: Okata and Kokubo, 1905.
J. of Milit. Surg. Assoc. (Japanese publication). From Philip. J. Sci. v. 1, 1906, p. 172. Usually occur as diplococci, but also singly or in groups. Stain irregularly. Not capsulated. Not motile. Cause of beriberi (Japanese "kakke"). Apparently not used in the generic sense.

Kalymmabacterium: Beaurefaire-Aragao and Vienna, 1912.
Brazil Med., July 22, 1912. Emended to *Calymmatobacterium* by same authors in 1913.

Karphococcus: Hohl, 1902.
Landw. Jahrb. d. Schweiz, v. 16, 1902, p. 342. See also Centralbl. f. Bakt., Abt. 2, v. 9, 1902, p. 338. Morphologically very much like *Micrococcus freudenreichii* Guillebeau, but somewhat smaller. Very different in its cultural characters, however.
Type species (monotypy)—Kharphococcus pituitoparus. Isolated from straw. Produces no indol in bouillon, but there is evolution of H_2S. Causes ropy milk. Average size 1μ. Grayish white on agar, no liquefaction of gelatin, no acid formed from milk.

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Karphokokkus: Hohl, 1902.

Variant of Karphococcus. Spelled in this manner in title of paper in citation given under *Karphococcus.*

Keratophyton: Rosenhauch, 1908.

Klin. Monatsbl. Augenheilk. Stuttgart (46), N. F. 6, 1908, 514–522. Doubtful as to its position—belongs either with the bacteria or with the "schimmelpilzen." Varied form and size. Some of the rods are so short as to appear like cocci, many are somewhat longer, others again (young cultures) form very long, wave-like, at times branched threads. Here and there are thick, spindle-shaped or irregular drawn-out forms, which sometimes are filled with vacuoles. Many of the rods are similar to the bacilli of chicken cholera. The cause of corneal ulcers.

Kladothrix:

Many German writers. Variant of *Cladothrix.*

Klebsiella: Trevisan, 1885.

Atti della Accad. fisio-medico-Stat. in Milano, 4 ser., v. 3, 1885, p. 105. Bacilli and cocci. The bacilli are cylindrical, straight, inarticulate, hyaline, of two forms: macrobacilli and microbacilli; cytoplasm homogeneous. The cocci are derived from the microbacilli, and are in monilia-like chains or solitary. Capsulated. No spores.

Type species (monotypy)—*Bacterium pneumoniae-crouposae* Zopf which becomes *K. crouposa.*

Kokkobacillus: Biedert, 1885.

Virchow's Archiv., v. 100, Berlin, 1885, p. 439.

Type species (monotypy)—*K. zymogenes.* An organism closely related to the proteus group. Of varying form and size, rods, cocci, etc. In the longer rods are refractive granules. The coccus forms (produced by the rods) exhibit a trembling motion. Gelatin not liquefied.

Kokkobacteria: Klebs, 1887.

Die Allg. Path., Jena, 1887, p. 310. Variant of *Coccobacteria* Billroth.

Kokkothrix: Unna, 1887.

Dermatolog. Studien herausgegeb. v. Unna, Heft 4, Hamburg and Leipzig, 1887, pp. 29 and 58. Variant of *Coccothrix* Lutz.

Kokkus:

Many German writers. Variant of *Coccus.*

Kurthia: Trevisan, 1885.

Caratteri di Alcuni nuovi generi de Batteriaceae. In Atti della Accad. fisio-med.-statistica in Milano, ser. 4 v. 3, 1885, p. 92. Three stages of development: (1) Filaments; (2) bacilli; (3) cocci. The filaments (typical protoplasmic stage) are cylindric; at first apparently inarticulate, later articulate, not colored, irregularly spiral, radiating from a central point. Bacilli (transitory stage) are cylindrical, inarticulate, straight, uniform, grouped into irregularly rounded colonies. The cocci (final stage) are at first united, later free. Spores not known.

Type species (monotypy).—*K. zopfii* Kurth.

Lactobacillus: Beijerinck, 1901.

Arch. Néerl. des Sci. ex. et Natur., Sér. 2, v. 4, 1900–1901, pp. 9 and 212. Rod-shaped organisms producing active lactic acid (usually laevo). Ferment milk at a temperature of 30° C. Nonmotile. He includes here: *L. fermentum, L. delbrucki,* and later adds a number of others.

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Lactobacillus (Beijerinck) emended Winslow, Broadhurst, Buchanan, Krumwiede, Rogers, and Smith, 1917.

J. Bact., v. 2, no. 5, Baltimore, 1917, p. 561. This committee placed the genus *Lactobacillus* under a new family—the *Lactobacillaceae*, characterized as below. Rods often long and slender, gram-positive, nonmotile, without endospores. Usually produce acid from carbohydrates, as a rule lactic. When gas is formed it is CO_2 without H_2. The organisms are usually somewhat thermophilic. As a rule microaerophilic. Surface growth on media poor. The generic characters those of family.

Type species (original designation).—*L. caucasicus* (Kern?) Beijerinck.

Lactobacter: Beijerinck, 1900 (?).

Centralbl. f. Bakt., abt. 2 v. 6, 1900, p. 200. See also Arch. Néerl. sér. 2, v. 4, 1900–01, p 9. A "natural genus." Aerobic rods, diplococci and micrococci, the "lactic ferments."

Lactococcus: Beijerinck, 1901.

Arch. Néerl. des. Sci. ex. et Nat., sér. 2, 1901, p. 212. Includes micrococci, diplococci and streptococci which at a temperature of 30° C. ferment milk with the production of lactic acid, usually the dextro acid.

Type species.—Lactococcus lactis (Leichmann).

Lactosarcina: Beijerinck, 1908.

Arch. Néerl. d. Sci. Ex. et Nat. sér. 2, v. 13, La Haye, 1908, p. 359. Found in distilleries, yeast factories, tanneries, etc. Produces active lactic acid. Nonmotile, nonsporulating, very resistant to drying. No catalase is ever formed.

Lamprocystis: Schröter, 1886.

Krypt.-Flora v. Schlesien, Cohn. v. 3, part 1, Pilze, 1885–1889, p. 151. Cells elliptical, at first in roundish solid heaps, later forming hollow sacks, in which the cells lie embedded in a slimy mass. Finally the membrane ruptures and becomes net-like.

Type species (monotypy).—*L. roseo-persicina Kützing.* Syn. (Schröter) *Microhaloa rosea* Kützing; *Protococcus rosea-persicina* Kützing 1849; *Pleurococcus roseopersicina* Rabenhorst; *Bacterium rubescens* Ray Lankester; *Clathrocystis rosea-persicina* Cohn, 1875.

Lampropedia: Schröter, 1886.

Same reference as for Lamprocystis, p. 151. Cells united in fours or more to form regular, flat tabular colonies, colorless or brightly colored (not green). Distinguished from *Merismopedia* Meyen only through lack of the green pigment.

Type species (monotypy).—*L. hyalina* (Ehrenberg, Kützing) Schröter. Cells spherical, colorless, about 2μ in diameter, 4 or several times 4 cells tabularly arranged, these plates reaching at times a diameter of 15μ. Habitat: In swampy water, etc.

Leptomitus: Agardh, 1824.

Syst. Algarum, 1824, p. 83. An algal genus into which some species of bacteria have been placed, e. g., according to De Toni and Trevisan (Sacc. Syllog. Fung. v. 8, 1889, p. 933): *Leptomitus divergens* Kützing, is synonymous with *Leptotrichia rigidula* (Kützing) Trevisan.

Leptonema: Rabenhorst (?). An algal genus. According to Trevisan (Sacc. Syllog. Fung. v. 8, 1889, p. 934) *Leptonema nivea* Rabenhorst (Alg. Decad. p. 653) is synonymous with *Letotrichia nivea* (Rabenhorst) Trevisan, and *Thiothrix nivea* Winogradsky.

Leptospira: Noguchi, 1917.

J. Exp. Med., v. 25, No. 5, Baltimore, 1917, p. 755, and idem. v. 27, no. 5, 1918, p. 576 and 584.

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Type species (monotypy).—*L. icterohaemorrhagiae* (Inada and Ido, 1914). Cause of infectious jaundice. Closely wound, 10 to 12 coils within 5μ, slender, cylindrical filaments with gradually tapering ends. Lengths 7 to 14μ; rarely 30 to 40μ; diam. 0.25 to 0.3μ. Spiral amplitude, 0.45 to 0.5μ. Spiral depth, 0.3μ regular. One or more gentle wavy curves throughout the entire length. In a free space one or both ends may be semicircularly hooked, while in semisolid media the organism appears serpentine, waved or bent. Flexible. No axial filament present; no chambered structure; no membrane; no crista; no flagellum; no terminal finely spiral filament; terminal or caudal (last 6 or 8 spirals) portion highly motile. Division transverse. Stains reddish violet by Giemsa's solution. Also places here *Spirochaeta biflexa* Wolbach and Binger. Noguchi considers this genus intermediate between the protozoa and bacteria. He later included the cause of yellow fever under this genus: *L. icteroides* Noguchi. See J. Exp. med. v. 29, 1919.

Leptothrix: Kützing, 1843.

Phycologia Generalis. Leipzig, 1843, p. 198. Trichomata simplicia tenuissima, monogonimica, turgida, continua, vel obsolete articulata, in stratum vel compactum, vel caespitosum, continuum, pleurumque late expansum complicata.

Type species (first in numerical order, and subsequent designation by many authors).—*L. ochracea* (Leiblein) Kützing; L. fluctuans, natans, ochracea; trichomatibus curvatis, intricatis, subtilissimis diameter $\frac{1}{1500}$ to $\frac{1}{1000}$ inch; articulis globosis vel oblongis.

Leptothrix: (Kützing) emend. Cohn, 1875.

Beit. z. Biol. d. Pflanzen, v. 1, h. 3, Breslau, 1875, p. 203. Cells arranged in unbranched threads; cylindric, colorless; very thin; long.

Leptothrix: (Kützing) em. Ellis,[1] 1907.

Cent. f. Bakt., Abt. 2, v. 19, 1907, p. 503.

Type species (monotypy).—*L. ochracea*. Usually associated with *Gallionella ferruginea*. A number of straight filaments free at both ends. The ends are often unsymmetrical. Membrane sharply contoured internally and externally. Breadth varies from 1.5 to 2μ, but when covered with ferric hydroxide often reaches 3μ, and more. Length reaches up to 200μ and possibly more. Formation of conidia takes place by a process of budding, constriction occurring as soon as the required length has been obtained. Sometimes the constriction is prolonged so that a number of quill-like structures are seen protruding from the organism. Eventually these are abstricted and elongate to form new threads. Conidia oval and 1μ by 1.5μ. Multiplication also occurs by cell division. At various unequal distances along both sides of the membrane small nodules are formed. Each nodule divides into two, the split taking place between the two daughter nodules. As the pairs of nodules are not exactly opposite the pairs on the other side of the membrane the daughter cells are not symmetrical at the ends. Nonmotile at all stages.

[1] Ellis (Cent. f. Bakt., Abt. 2, v. 26, 1910. p. 324) makes the important observation that the iron bacteria may be classified according to the following scheme: Group 1. Those which reproduce by external abstriction of conidia: *Leptothrix ochracea, Gallionella ferruginea,* and *Spirophyllum ferruginea.* Group 2. Those which reproduce by the separation of internally produced cells: *Crenothrix polyspora, Cladothrix dichotoma,* and *Clonothrix fusca.* In addition he had earlier (Cent. f. Bakt., Abt. 2, v. 19, 1907), made the distinction that *Leptothrix* and *Gallionella* possessed cylindrical threads, while his two genera *Nodofolium* and *Spirophyllum* were flattened bands. All of these genera he considers as belonging to the thread bacteria.

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Leptothrix: (Kützing) emend. Buchanan, 1918.

J. Bact., v. 3, no. 2, Balto., 1918, p. 303. Filaments of colorless cells, with a sheath at first thin and colorless, later thicker, yellow or brown, becoming encrusted with iron oxide. Multiplication through division and abstriction of cells and motile cylindric swarm cells. Swarm cells sometimes germinate in the sheath giving the appearance of branching. Pseudodichotomous branching may occur.

Type species (original designation).—*L. ochracea* (Leiblein) Kützing. (Note.—Buchanan states that this conception of *Leptothrix* renders the genus represented by *Leptothrix buccalis* invalid.)

Leptothrix: Robin, 1847.

Des vegetaux qui croissent sur les animaux vivants. Paris, 1847, p. 42. According to Hist. nat. des. Végét. Paras, etc., Paris, 1853, p. 345. *L. buccalis* Robin.—Trichomatibus, rigidulis, linearibus, rectis, vel inflexis non moniliaformibus, achromaticis, extremitatibus obtusis, basi in stromate amorpho granuloso adhaerentibus. Length, 0.02 mm. to 0.1 mm.; breadth, 0.0005 mm. Habitat: In superficie linguae, inervallis dentium, cavo dentium corruptorum, et in succis stomachi et intestini.

Leptotrichia: Trevisan, 1879.

Rend. Reale Ist. Lombardo, Ser. 2, v. 12, 1879, p. 138. Somatia cylindrica, plus minus distincte articulata, tenuia, elongata, filiformia, recta, laxe, fasciculata. In Trevisan's original paper he named no species.

Leptotrichia: (Trevisan) em. Committee Soc. Am. Bact., 1917.

J. Bact., v. 2, 1917, p. 206. Thick, long, straight or curved threads, frequently clubbed at one end and tapering at the other. Gram positive when young. Nonmotile. Filaments sometimes granular; non-branching. No aerial hyphae or conidia. Parasites or facultative parasites.

Type species (original designation).—*L. buccalis* (Robin) Trevisan.

Leptotrichiella: Trevisan, 1889.

Sacc. Syllog. Fung., v. 8, 1889, p. 935. A subgenus of *Leptotrichia.*

Leucocystis: Schröter, 1883.

According to Schröter: Krypt.-Flora v. Schlesien. Cohn. v. 3, pt. 1, 1885–1889, p. 152. Cells spherical or short elliptical, single or several united by a large, several layered plainly contoured, gelatinous membrane, and flowing together into slimy masses.

Type species (monotypy).—*L. cellaris* Schröter. Syn. (Schröter) *Erebonema hercynicum* (Kützing). Cells spherical or short elliptical, 1.5 to 2μ long by 1 to 1.5μ broad, strongly light refracting. Found in cellars, etc. Schröter later (Ber. u. d. Thät. bot. Sec. d. Schles. Gesellsch., 1883, p. 197) included Friedlander's *coccus* here as *L. pneumoniae.*

Leuconostoc: Van Tieghem, 1878.[1]

Annales d. Sci. Nat. Bot., v. 7, Paris, 1878, p. 198, pl. 16. Cellulae achromaticae minimae globosae, in catenas laxas flexuoso-curvatas et implicatus, vagina gelatinoso-cartilaginea lobata crassissima circumdatas, consociatae. Vaginae in thallum gelatinoso-cartilagineum, subglobosum, vel crassissime membranaceum, irregulariter expansum, extus cerebroideum, intus pseudo-parenchymaticum aggregatae. Sporae singulae, globosae, majores, terminales vel interstitiales pachydermaticae, intus homogenea.

Type species (monotypy)—*Ascococcus mesenterioides* Cienkowski, found in cane sugar solutions.

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[1] See emend. by Com. Soc. Am. Bact. (in J. Bact., v. 5, 1920, p. 206): Saprophytes; cells in chains, or pairs united in large zoogleal masses. Same type.

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Leucothrix: Örsted, 1844.

De regionibus marinis, p. 44. According to Saccardo's Sylloge Fung., v. 8, 1889, p. 933. *L. mucor*, synonymous with *Leptotrichia mucor* (Oersted) Trevisan. Trevisan makes this genus a subgenus of his *Leptotrichia*.

Lineola: von Baer, 1827.

Nova Acta Phys.-Med. Acad. Caes. Laop. Nat. Cur., v. 13, 1827, p. 748. Löffler and other early writers express the belief that von Baer included bacteria under this name. "Die Reihe für die Thiere des Typus mit vorherrschender Längendimension beginnt mit lebendigen Fäden; *Lineola* (so mögen die einfachsten Vibrionen heissen), repräsentirt sie unter den Protozoen. Auf der ersten Entwickelungstufe werden sie zu lebendigen Röhren mit Keimen, Vibrio," etc.

Lipobacter: Kruyff, 1907.

Bull. de Dept. de l'Agricult. aux Indes Néerl. No. 9 (Micro-biol. 3), Buitenzorg, 1907, pp. 1–13. Motile or nonmotile rods, or cocci, which oxidize and hydrolyze fats. Obtained from soil, river water, sewage water, rancid butter, and in the excrement of various animals. Oxidize free fatty acids of high molecular weight. Describes several species, calling them *Lipobacter* 1, 2, 3, etc. *Lipobacter* 9=*Bact. fluorescens liquefaciens*.

Liquidobacterium: Jensen, 1909.

Centralbl. f. Bakt., Abt. 2, v. 22, 1908–9, p. 338. Spore-free, peritrichiate rods; aerobic; liquefying gelatin—the *Proteus* group.

Species.—*L. prodigiosum* (Ehrenberg, 1839); *L. vulgare* (Hauser).

Liquidococcus: Jensen, 1909.

Centralbl. f. Bakt., Abt. 2, v. 22, 1908–9, p. 332. Polar flagellate cocci, liquefying gelatin.

Liquidomonas: Jensen, 1909.

Centralbl. f. Bakt., Abt. 2, v. 22, 1908–9, p. 332. Polar flagellate, obligate aerobes; fluorescent and dentrifying.

Species.—*Bact. fluorescens liquefaciens L. fluorescens; L. pyocyanea; L. schirokikki* (Cent. f. Bakt., Abt. 2, v. 2, 1896, p. 205).

Liquidovibrio: Jensen, 1909.

Centralbl. f. Bakt., Abt. 2, v. 22, 1908–9, p. 333. Polar flagellate vibrios, liquefying gelatin. Frequently luminous.

Type species (monotypy).—*Vibrio cholerae*.

Macrococcus:

Found frequently in literature, but not used in a generic sense. See Lipp. Med. Dict., Philadelphia, 1910, p. 524.

Madurella: Brumpt, 1905.

Compt. Rend. de la Soc. de Biol., v. 1, Paris, 1905, p. 997. Brumpt defined this genus as belonging to the Mucedinaceae; type species *Streptothrix mycetomi* (Laveran).

Makrokokkus: Miller, 1892.

Mikroorg. d. Mundhöhle, 1892, Ed. 2, p. 73. Variant of *Macrococcus*.

Mantegazzaea: Trevisan, 1879.

Reale Istit. Lombardo. ser. 2. v. 12, 1879, p. 137. See Saccardo's . v. 8, 1889, p. 942. Somatia fusiformia vel cylindrica, dis- ata, valida, abbreviata, recta, segreguta. Sporae ignotae. versali sese multiplicantes.

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Species *M. cienkowskii*. Baculis fusiformibus, apicibus acutis, achrois, immobilibus, 4 to 5.5μ to 2 to 2.5μ. *M. articulata* (*Bact. articulatum* and *Bact. triloculare* Ehrenberg).

Mantegazzaea: Trevisan emend. Vuillemin, 1913.

Ann. Mycol v. 11, Berlin, 1913, p. 521. A "formogenre" characterized by fusiform elements.

Type species (original designation).—*M. hastilis* (*Bacillus hastilis*) Seitz, 1889. It is the "Bacille fusiforme des medecins." See *Fusiformis* Hoelling.

Mastichemonas: Diesing, 1850.

Systema Helminthum, v. 1, Vindobonae, 1850, p. 22. A sub-genus of *Monas*. Animalcula solitaria libera. Corpus ecaudatum, elongatum, subglobosum, ovatum, turgidum, v. planum, haud v. mollitie sua solum mutabile, divisione spontanea simplici perfecta bipartitum v. indivisum. Os terminale. Flagellum simplex. Ocellus nullus. Est Parenema (Euparenema) corpore haud mutabile. Includes under this subgenus 22 species: *Monas* (*Mastichemonas*) *termo* Müller (Ehrenberg), *M.* (*Mastichemonas*) *punctum*, *M.* (*M.*) *lens*, *M.* (*M.*) *okenii*, etc.

Megabacteria: Billroth, 1874.

Untersuchungen über die Vegetationsformen v. Coccobacteria septica, Berlin, 1874, p. 16. Pl. 4, fig. 29. Large rods, occurring singly or in pairs.

Megabacterium: Lipp. Med. Dict., Phila., 1910, p. 544.

Megacoccos: Billroth, 1874.

Same citation as for Megabacteria, p. 6. The largest of the coccos forms. This form "passes over" into the smaller form.

Megacoccus: Miller, 1886.

Syn. (Miller), *Macrococcus*. Wörterbuch d. Bacterienkunde, Stuttgart, 1886, p. 23.

Megalothrix: Schwers, 1912.

Centralbl. f. Bakt., Abt. 2, v. 33, 1912, p. 273, 5 pls. Thread forms belonging to the iron bacteria.

Type species (monotypy).—*M. discophora*.[1] Threads 300μ long, and 8 to 12μ wide, which contain longish cells. Distinguished from *Leptothrix* by the possession always of a delicate sharply defined canal, and a very wide, homogeneous or very finely granular, gray, bright yellow or bright orange sheath, whose circumference decreases gradually toward one end of the thread; dichotomy rare; seldom possible, because of thickness of sheath, to observe the division of the threads into the long cells.

Melanella: Bory de St. Vincent, 1824.

Encyclopedia Methodique (Zooph.) 1824, pp. 46 and 511. See also Essai d'une Classif. des Animaux Microscopiques. Bory de St. Vincent, Paris, 1825, p. 18, and Dict. Class. d'Hist. Nat., Paris, June, 1826, v. 10, pp. 517 and 533. "Miscroscopiques" beonging to the order Gymnodes, and to the family Vibrionides. They are deprived of all appendages, are linear or needlelike; have an opaque body not rolled into a discoidal spiral. No definite motility observed—a sort of vibration described. Found frequently in emulsions of muscle, macerated human testicle (*Melanella spirillum*), fermented urine, sea water, etc. He included here: *M. atoma* Bory de St. Vincent. [Syn. (Ehrenberg) *Vibrio lineola* Müller]; *M. monadina*. *M. punctum* Müller; *M. flexuosa* (*V. rugula* Müller); *M. spirillum* (*Vibrio spirillum* Müller). Vuillemin (Ann. Mycol. v. 11, Berlin, 1913, p. 578) says

[1] Synonymous (according to Ellis in Cent. f. Bakt., Abt. 2, v. 44, 1913, p. 449) with *Leptothrix meyeri* Ellis, which Ellis decided later to be merely a peculiar mucilaginous development of a *Crenothrix* thread.

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it is believed that the type of this genus (*M. monadina* Bory, 1824) is identical with *Monas punctum* Müller 1786. His own opinion is that this is problematical, but that the species might be *Bacterium punctum* Ehrenberg, 1830 (*Bacillus punctum* Trevisan, 1889). He rejects it as a valid genus.

Melococcus: Nedrigailov, 1907.

Charkov. Med. Zurn., v. 4, No. 9, Charkov, 1907, p. 301. See also Amiradzibi, p. 309.

Type species (monotypy).—*M. ostrajanini*. A small gram-positive coccus, occurring sometimes in small chains or clusters. Found in the intestinal tract of *Galleria melonella* (bee moth), but not pathogenic to this insect even when it is fed upon it, but pathogenic to man.

Meloseira (Melosira) Agardh, 1824. Syst. Alg., 1824, p. 8. A diatom genus into which species of bacteria have been erroneously placed, e. g., *M. minutula* Brébisson Syn. (Trevisan, Sacc. Sylloge, Fungorum, v. 8, 1889, p. 1007) *Spirillum ferrugineum* (*Gallionella ferruginea* Ehrenberg).

Meningococcus: Foà and Bordono-Uffreduzzi, 1888.

Ztschr. f. Hyg., v. 4, 1888, p. 67.

NOTE.—A search through several hundred papers on the organism causing cerebro-spinal meningitis makes it rather probable that these authors were the first to use the term "meningococcus." So many papers were published in the same year, however, and in the majority of cases the exact time of the year is not stated, so that it is impossible to be very certain in this case. They merely used it as a designation for the organism they had studied, and did not define it as a genus, naming no species. They considered their organism identical with the "Pneumococcus," causing croupous pneumonia as well as spinal meningitis. So they conclude that "könnte der fragliche Mikroorganismus allgemein mit *Diplococcus lanccolatus* oder *capsulatus* bezeichnet werden, da sein Hauptmerkmal das ist, dass er Diplococcus ist, eine kleine Lanze bildend, und mit Kapseln versehen. Zu diesen Namen könnte man dann noch, je nach den Fallen Pneumoniae, sive Menigitis cerebro-spinalis u. s. w. hinzusetzen." See *Meningokokkus* Huebner, 1896.

Meningococcus: Coats and Forbes, 1911.

M. intracellularis. Proc. R. Med. Soc., v. 4, 1911, p. 242.

Meningococcus:

M. intracellularis (Weichselbaum) Kraus, 1913. Hand. d. Path. Org. Kolle & Wassermann, v. 2, Jena, 1913, p. 783.

Meningokokkus: Huebner, 1896.

Jahrb. f. Kinderheilk., n. f., v. 43, 1896, p. 3. Renames the organism described by Weichselbaum as the cause of spinal meningitis under the name *Diplococcus intracellularis meningitidis: Meningokokkus intracellularis* "wie der Organismus wohl am Besten—zum Unterschiede vom Pneumokokkus—genannt wird."

Merismopedia: Meyen, 1828.

Nova Acta Naturae Cur., v. 14, Bonn, 1828–29, p. 771. See also Archiv. f. Naturgeschichte (Wiegmann), Berlin, 1839, v. 2, p. 67.

Species.—M. punctata. Meyen defined this genus as a phycochromaceous alga. Rabenhorst (Flora Europea Alg., Sect. 1–2, 1864–65, p. 58) places *Sarcina reticuli* Goodsir here.

Merismopedium: Caspary, 1874.

Schriften d. Physikal.—Ökonomischen Gesell. z. Königsb. v. 14–16, 1873–1875, p. 1. *M. reitenbachii*, n. sp. Describes an alga under this name, stating that Meyen, Rabenhorst, Kützing, et al, were incorrectly writing Merismopedia.

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Merismopedia: Zopf, 1885.

Die Spaltpilze, Zopf. Breslau, 1885, pp. 51 and 54. Cocci, consisting of spherical elements arranged in plates. Division in two directions, leading to the formation of cell layers in platelike arrangement.

Type species (monotypy).—*M. gonorrhoeae.* The cause of gonorrhoea; 0.83μ in diameter.

Merista: Banks and Soland in Mss. 1769.

According to Cunningham (Ann. Nat. History. v. 10, B. II, London, 1839, p. 47). *Merista laevigata* Banks and Soland is syn. with *Myrsine urvillei*, one of the higher plants.

Merista: Van Tieghem, 1884.

Traité de Botanique, Paris, 1884, p. 1114. "Bactériées," dividing in 2 directions, membraneous body, dissociating into tetrads, as they divide.

Merista: Prazmowski, 1888.

Verh. d. k. k. Akad. d. Wissensch. in Krakau. Math.-Nat. Sekt., v. 18, 1888, p. 235. See also Bot. Cent., v. 36, 1888, p. 259.

Type species.—M. ureae (Cohn).

Mesobacteria: Billroth, 1874.

Same reference as for *Megabacteria*, p. 6. Pl. IV, fig. 28. Average-sized rods. Following Hoffmann.

Mesococcos: Billroth, 1874.

Same reference as for *Megabacteria*, p. 6. Pl. 1, fig. 3. Medium-sized form of Micrococcos. Motile and nonmotile. See *Coccobacteria.*

Mesococcus: Miller, 1886.

Wörterbuch d. Bacterienkunde, Stuttgart, 1886, p. 23. A medium sized coccus.

Metabacterium: Chatton and Pérard, 1913.

Compt. Rend. Soc. Biol., v. 74, Paris, 1913, p. 1232.

Type species (monotypy).—*M. polyspora* n. sp. Found in the caecum of the guinea pig. Characterized by its ability to form from 1 to 8 spores in a single cell. A truncated spindle-shaped organism, always single, 10 to 25μ long by 5μ wide. Nonmotile. Cytoplasm condensed into chromatic masses, from which the spores develop, which (when limited to 2) are usually bipolar. The vegetative forms have never been observed to divide. Nonpathogenic.

Metacoccus: Conn, 1909.

Agricultural Bacteriology, Conn. 1909, Ed. 2, p. 12.

Metallacter: Perty, 1852.

Zur Kenntniss der kleinster Lebensformen. Perty. Bern, 1852, p. 180. "Bacteria-like" individuals, which lengthen by division to rigid or slightly flexible threads which under certain conditions lose their motility. The threads are colorless or gray.

Type species (monotypy).—*M. bacillus* Müller. Vuillemin (Ann. Mycol. v. 11, 1913, p. 519) states that this genus is synonymous with *Serratia* Bizio.

Methanomonas: Jensen, 1909.

Centralbl. f. Bakt., Abt. 2, v. 22, 1908–9, p. 311. Monotrichiate short rods, capable of oxidizing methane to carbon dioxide and water.

Type species (monotypy).—*Bacillus methanicus* Söhngren.

Microbacillus: (Sabouraud) Schamberg, 1902.

Zurn. dermatol, sifilidol., St. Petersburg, v. 2, 1902, p. 293. According to Int. Cat. Sci. Lit., R., Bact., v. 3, London, 1905, p. 247. *M. seborrhoeae.*

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Microbacteria: Billroth, 1874.

Same reference as for *Megabacteria*, p. 6. Pl. 4, fig. 27. Small rods, some of them with clubbed ends. Appear to result from the stretching of the previously described *Mesococcos;* club-shaped ends perhaps resting spores. Motile. From spoiled milk. See *Coccobacteria.*

Microbacterium:

Cited by Smith in Bacteria in Rel. to Plant Dis., v. 1, Carnegie Inst., Washington, D. C., 1905, p. 174.

Micrococcos: Billroth, 1874.

Reference same as for *Megabacteria*, p. 6, pl. 1, fig. 2. The smallest form of coccos. Thinks they may be produced from resting spores, and that they enlarge giving rise to *Mesococcos* and *Megacoccos.* See *Coccobacteria.*

Micrococcus: Hallier, 1867 (?).

Bot. Zeitung, v. 23, 1865, p. 144. See also Gährungscheinungen. Unters. über Gährung, etc., Leipz., 1867, p. 108, and Paras. Unters. auf die Pflanzl. Oreg., etc., Leipzig, 1868, p. 67. In the earlier reference he described the "hefe" cells which he in 1867 called *Micrococcus.* "Die ganze bisher aufgefundene Metamorphose des Plasmakerne und Schwarmer lässt drei verschiedene Stufen erkennen. Die erste Stufe bildet die Kernhefe, man könnte sie als *Protococcus* bezeichnen, wäre nicht dieses Ausdruck zu allgemein auf eine Algengruppe angewendt. Ich schlage daher die Bezeichnung *Micrococcus* vor. Der Micrococcus (deutsch Kernzellen oder Kernhefe), die Hefe der Fäulniss, Gallussäure-gährung, Umwandlung der Starke u. s. w. entseht aus schwärmender oder ruhenden Kernen, welche ohne Membran einen so fort freiwerdenen Tochterkern abschnüren. * * * Die Leptothrix-Ketten sind * * * nur Kerne welche im Zusammenhang bleiben in Folge des Einflusses der Luft, also unvolkommene Kernehefe, man könnte sagen: *Oidium micrococci.*" From this it may be seen that Hallier gave no definition of the term. Some of his figures indicate that he had species of micrococci under study. In another paragraph in second reference given, p. 4, he speaks of *Micrococcus* as the smallest and simplest "Hefeform." See also Das Cholera Contagium. Bot. Untersuch. Aerzten und Nat. Leipzig, 1867, where he discusses his "cholera *Micrococcus.*" In many paragraphs in these references Hallier points out what he thought to be the transformation of his *Micrococcus* into the Mucoraceae and Ustilaginaceae.

Micrococcus: (Hallier) emend. Cohn, 1872.

Beitr. z. Biol. d. Pflanzen, v. 1, Heft 2, Breslau, 1870–1875, p. 151. Cells colorless or delicately colored; very small, spherical, or oval; forming through cross-division two or several-membered rosary-like chains (mycothrix, torula-form), or united into many-celled families (colonies, balls, heaps), or slime-masses (zoogloeae-form, Mycoderma-form). Includes here: *M. prodigiosus*, Syn. (Cohn) *Monas prodigiosa* Ehrenberg; *Palmella prodigiosa* Montagne; *Bacteridium prodigiosum* Schröter, *M. aurantiacus, M. chlorinus*, etc.

Micrococcus (Hallier, Cohn) em. Winslow and Rogers, 1905.

Science, n. s., v. 21, 1905, p. 559. See also J. Inf. Dis., 1906, v. 3, p. 485; The systematic Relationships of the Coccaceae, Winslow and Rogers, New [illegible], 1908, and Biol. Studies by the Pupils of W. T. Sedgwick, Boston, 1906, p. 205. Facultative parasites or saprophytes. Cells in plates or

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irregullar masses (never in long chains or packets). Generally decolorize by Gram. Growth on agar abundant, with formation of yellow pigment. Dextrose broth slightly acid, lactose broth generally neutral. Gelatin frequently liquefied. Nitrates may or may not be reduced. They include here: *M. orbicularus* Ravenel, *M. luteus* (Schröter) Cohn, and *M. ochraceus*, Rosenthal.

Type species (subsequent designation by Buchanan, J. Inf. Dis., v. 17, No. 3, 1915, p. 536).—*M. luteus* (Schröter) Cohn.

Microhalea: Kützing, 1843.

Phycol. Generalis, p. 169. An algal genus. *M. rosea* Kützing (Linnea, v. 8, p. 341), according to Cohn and Migula is synonymous with *Lamprocystis roseo-persicina* (Cohn) Schröter.

Micromyces: Gruber, 1891.

Münch. med. Woch., 1891, p. 653. See also Arch. f. Hyg., v. 16, Munich, 1893, p. 35. Defined it as a hyphomycete. Lehmann and Neumann (Bact., v. 2, Weaver's Trans., Philadelphia, 1901, p. 447) say it is synonymous with *Actinomyces*. In very young cultures cells appear as short rods less than 1μ in diameter, somewhat longer. The rods are frequently curved and knotted. These thickenings represent the beginning of branching. Branching continues until brush-like masses occur at the ends of the rods. Tendency toward fragmentation characteristic. The old mycelium often has the appearance of coccus chains. Fructification not observed.

Type species.—Micromyces hoffmanni. (Spelled also "*Mikromyces*" in text.)

Micromyces: Dangeard, 1888.

Le Botaniste, v. 1, 1888, p. 55. A phycomycetous fungus.

Microsphaera: Cohn, 1872.

Virchow's Arch. f. Path. Anat. u. Phys., v. 55, Berlin, 1872, p. 229. Spherical bacteria. Cells colorless, very small, spherical or spheriodal. Nonmotile usually. In chains of 2, 4 or 8, or in irregular groups or colonies, or in slime-masses (zoogloeae). Resting spores are formed (?)

Type species (monotypy).—*M. vaccinae.* Found in "Pockenlymph."

NOTE.—Cohn (Beitr. z. Biol. d. Pflanz. 1, Heft 2, 1870–1875) states later that he overlooked *Microsphaera* Léveillé 1851 (an epiphytic fungus), and so in order not to use the same name, adopts Hallier's *Micrococcus*.

Microspira: Schröter, 1886.

Kryptogamen-Flora v. Schles. Cohn, v. 3, pt. 1, Pilze, 1885–1889, p. 168. Vegetative cells slightly curved (comma-like), usually with only a half spiral, actively motile by means of 1 wavy polar flagellum (rarely 2 or 3). Single or several united, when screw-like or Spirochaete-like threads are formed. Spores are formed through division of members of the chains (arthrospores).

Species.—M. comma. Syn. (Schröter) the "comma-bacillus" of Koch, 1884. Habitat: In the alimentary tract causing Asiatic cholera. *M. finckleri* (Koch, 1884), and *M. buccalis* (Lewis, 1884).

Microspira (Schröter) em. Migula, 1894.

Arb. aus d. Bact. Inst. d. Tech. Hoch. z. Karlsruhe, v. 1, h. 2, 1894, Karlsruhe, 1897, p. 237. Rigid cells with 1, rarely 2 to 3 polar flagella, which are wavy, bent.

Type species (monotypy).—*M. comma* Schröter.

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Microspironema: Stiles and Pfender, Dec. 2, 1905.

American Med., v. 10, Philadelphia, 1905, p. 936. Follow Vuillemin's objections to the generic name *Spirochaeta* Ehrenberg (*Spirochaete* used by Schaudinn) for the organism causing syphilis. Because of Vuillemin's generic name being preoccupied (Meeks, 1864), they propose *Microspironema*.

Type species (original designation).—*M. pallidum* (Schaudinn, 1905).

Microspora: Beijerinck.

Variant of *Microspira* Schröter. *M. tyrosinatica*.

Microsporon: Klebs, 1871.

Correspondenz-blatt f. Schweiz. Aerz., No. 9, Sept. 1, 1871, Bern, p. 241. *M. septicum*. Mycelial-like threads similar to *Leptothrix buccalis* distinguished from it through the exceeding fineness of the threads, which form thick brush-like masses in the destroyed tissues. On the upper surface of these brushes there develops a tough layer of very small spores. Habitat: Infected wounds

Microzyma: Béchamp, 1867.

Compt. Rend. d. Sci. de l'Acad., v. 64, Paris, 1867, p. 231. A "vibrion"; "corpuscule vibrant." Division in two directions. The division in direction of its long axis is first evident as a black line, which later becomes granular. Just prior to division some of the forms are 2 to 3 times normal diameter. Under the influence of creosote the cells elongate and swell up to 2 or 3 times normal size and transverse division is observed. Mycelial-like threads sometimes formed. Motile. Inverts sugar with production of alcohol, acetic acid or one of its homologues, and a nonvolatile acid.

Species.—M. cretae, M. bombycis. Cause of "pébrine" in silk worms.

Mikrococcus: Unna, 1889, and numerous German writers.

Variant of *Micrococcus*. Monats f. Prakt. Dermatol. Unna., v. 9, Leipzig, 1889, p. 393. *M. ulceris* (de Luca).

Mikrokokkus: Hueppe, 1885.

Die Formen d. Bakt., Hueppe. Lepzig, 1885, p. 148. Cocci, arranged in irregular heaps, without definite grouping.

Mikromyces: Gruber, 1891.

M. hofmanni Gruber. Variant of *Micromyces* Gruber.

Mikrospironema: Gonder, 1914.

Handb. d. Path. Protoz., Prowazek, 6 Lief., Leipzig, 1914, p. 690. Variant of *Microspironema*.

Modderula: Frenzel, 1897.

Biol. Centralb. v. 17, No. 22, Nov. 15, 1897, p. 801. Cells ellipsoid, surrounded by a strong membrane; contain small, round granules (sulfur?), and larger particles occasionally. Somewhat motile. No flagella stained. 12μ by 9μ to 50μ by 30μ.

Type species (monotypy).—*M. hartwigi*. Syn. (Migula, Syst. d. Bakt., v. 2, 1900, p. 1037) *Achromatium oxaliferum* Schewiakoff. See also Lauterborn, Biol. Centralbl., v. 18, 1898, No. 3.

Monobacteria: Billroth, 1874.

Reference as for *Megabacteria*, p. 16. Fine rods, occurring singly.

Monococcos: Billroth, 1874.

Reference as for *Megabacteria*, pp. 5 and 244. A *Megacoccus* occurring —single spherules.

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Monas: Müller, 1773.

Vermium terrestrium et fluviatilium. Havniae, 1773, part 1, p. 25. See also Animalcula Infusoria Fluviatilia et Marina, Havniae, 1786, p. 1, pl 1.[1] Vermis inconspicuus, simplicissimus, pellucidus, punctiformis. Placed the genus under the group of *Infusoria crassiuscula*.—Infusors with no external organs.

Type species.—M. termo.[2] Animalculum omnium, quae microscopium simplex offert, minimum, simplicissimum, punctulum, gelatinosae, substantiae pisum microscopium composirum eludere videtur, dum ne quidem sub hoc distinctius appareat. Sphaericum, an orbiculare? haud video. Guttula aquae, in qua maceratio facta est, his corpusculis adeo saepe repletur, ut ne minium vacuum distingui liceat, ipsamque aqae substantium in aliam minus hyalinam, globularum ex punctis confertissimis, omnem calculum superantibus mutatam crederes. In hac massa motus, qualem radii folares in aqua micantes effingere folent, oculis exhibetetur, dum animalcula, examinis apum instar, vehementer commoventur. In infusione vegetabilium et animalium. Hujus guttula jam intra viginti quatuor horas conspicitur quasi massa globularis, at nullus in a motus nec odor percipitur,.brevi vero motus fermentatio cum foetore intolerabili insequitur, at non in omni.

M. punctum, M. atomus, M. ocellus, M. hyalina, etc.

Monas lens, and *M. mica*. Later (1786) he included *M. punctum, M. atomus, M. ocellus, M. hyalina*, etc.

Monas (Müller) emend. Ehrenberg, 1828, 1838.

Symbolae physicae seu Icones et Descript. Animalium Evertebratorum, etc. (Decas Prima, Berolini ex Officina Academica, 1828, Phytozoa, p. 17, pl. 1, fig. 6. See also Die Infusionsthierchen, etc. Leipzig, 1838, p. 11. Family Monadina. *M. inanis, M. simplex*, etc. In the reference last given he further characterizes the genus, and describes the species *M. crepusculum*, which Cohn (Beit. z. Biol. d. Pflanz., v. 1, Breslau, 1875, p. 160) renames *Micrococcus crepusculum*.

Monococcus: Miller, 1886.

Wörterbuch. d. Bacterienkunde, Stuttgart, 1886, p. 27. Syn. *Micrococcus*.

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[1] On this plate both cocci and rods are shown.

[2] See Stiles, Bull. 24, Hyg. Lab., Treas. Dept., U. S. Public Health Service, Washington, 1905, p. 30, where he gives the following history of the three species first described by Müller:

1. ***Monas termo*** Müller, 1773. * * * Ehrenberg, 1830–1832, claims to have recognized this same species, adopting the name *Monas termo* (Müller) but later authors (Dujardin, 1841, p. 212; Diesing, 1850, pp. 16, 28) consider Ehrenberg's form distinct. Ehrenberg, 1832, p. 70, also mentions a "*Bacterium? termo.*"

Dujardin, 1841, p. 212, transferred "*Monas termo* Muller, non-Ehrenberg" to *Bacterium* as *Bacterium termo* (Müller) Dujardin, and the species is retained here in Diesing, 1850, p. 16.

Migula, 1897, states that *Monas termo* Müller can with some certainty be viewed as belonging to the bacteria; Cohn (1872) accepts *Bacterium termo* (as limited by Dujardin) as one of the two species of the genus *Bacterium* as emended by him.

2. ***Monas lens*** Müller, 1773. Retained in *Monas* by Dujardin, 1841; placed in subgenus *Mastichemonas* by Diesing, 1850. Migula, 1897, thinks this species belongs to the bacteria.

3. ***Monas mica*** Müller, 1773. Retained in *Eumonas* (typical subgenus of *Monas*) by Diesing, 1850. This species is thus seen to be type of the genus *Monas* by elimination, and as limited by Diesing, 1850.

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Morococcus: Lipp. Med. Dict., Philadelphia, 1910, p. 581.
A coccus found in eczematous skin.

Mycobacillus: Chantemesse, Matruchot, and Grimberg, 1917.
Compt. Rend. d. Sci. de l'Acad. de Paris, v. 164, 1917, p. 652.
Type species (monotypy).—*M. synovialis.* Intermediate between the "micromycetes" and true bacilli, hence the name. Young cultures actively motile. Rod-like organism. Spores by "enkystement partiel." The older filamentous growths lose their motility. Certain portions of the filaments are gram-positive, others gram-negative. Isolated from cerebral ventricle in case of acute arthritis.

Mycobacterium: Lehmann and Neumann, 1896.
Atlas u. Grund. d. Bakt. v. 2, 1896, p. 367. According to Atlas and Principles of Bact., Weaver's trans., Phila., 1901, pp. 128 and 410. Thin, slender rods, often with typical dichotomous branching, sometimes forming unbranched threads. Irregular or club-shaped forms rare in culture, more frequent in tissues. Acid fast. Cultures dry and wrinkled.
Type species (first in order of arrangement).—***Bacillus tuberculosis*** (Koch) Lehmann and Neumann.

Mycoderma: Persoon, 1822.
Mycologia Europaea, Sectio prima, Persoon, 1822, p. 96. Orbiculare coriiforme, primo molle, subpellucidum dein induratum, substantia ubique aequali.
Type species (first in order of arrangement, and subsequent designation by many authors).—*M. ollare.*

Mycoderma: Thomsen, 1852.
M. aceti. According to Migula (Die Syst. d. Bakt., v. 2, 1900, p. 400), who says the species is synonymous with *Bacterium aceti* (Kützing) Zopf.

Mycoderma: (Persoon) emended Committee, Soc. Am. Bact., 1917.
J. Bact., v. 2, No. 5, Baltimore, 1917, p. 551. Cells rod-shaped, frequently in chains, nonmotile; cells grow usually on the surface of alcoholic solutions, securing growth energy by the oxidation of alcohol to acetic acid. Also capable of utilizing other carbonaceous compounds, as sugar and acetic acid. Elongated, filamentous, club-shaped, swollen and even branched cells common and quite characteristic.
Type species (original designation).—*M. aceti* Thompson (?).

Mycomonas: Jensen, 1909.
Centralbl. f. Bakt., Abt. 2, v. 22, Jena, 1908–9, p. 329. Renames the genus *Mycobacterium* Lehmann & Neumann.

Myconostoc: Cohn, 1873.
Ber. u. die Thät. d. bot. Sect. d. Schles. Gesellsch., 1873, p. 45. See also Beit. z. Biol. d. Pflanzen. Cohn., v. 1, Heft 3, Breslau, 1875, p. 183 and 204. Filamenta tenerrima achroa implicata convoluta muco inclusa in globulos perparvos congesta.
Type species (monotypy).—*M. gregarium.* Globuli gregarii in superfice aquae putridae natantes. The spheroidal or elliptical masses measure 10 to 17μ in diameter. Reproduction by division of the gelatinous mass itself. Segmentation not observed. If the gelatinous masses are pressed the threads break [illegible] to short cylindrical, semicircular or ring-shaped segments.
[illegible]amnion: Kützing, 1846.
[illegible]col. Germanica, Leipz., 1846, p. 126. See also Phycol. Generalis, 1843, [illegible]. Defined as an alga, belonging near Leptomitus, Hygrocrocis, etc. *M.* [illegible]*icola.* Bacteria have been erroneously included here.

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Mycothece: Hansgirg, 1888.

Oesterr. Bot. Zeit, 38, Vienna, 1888, p. 227–230 and p. 266. Cells cylindric, straight or slightly curved in the middle; usually 1 to 1.5μ thick, rarely 2 to 3μ, and 3 to 6 times as long; colorless, single rarely in twos or fours, capsulated, not motile; reproduction by transverse division, spore formation unknown. The gelatinous masses are yellow to yellow-brown. Found in cellars and other damp places.

Type species (monotypy).—*M. cellaris* Hansgirg.

Mycothrix: Itzigsohn, prior to 1868, emend. Hallier, 1868.

According to Hallier: Parasitol. Untersuch. auf die Pflanz. Org., Leipzig, 1868, p. 7. Hallier emends Itzigsohn's term to include the "Leptothrix" chains of *Micrococcus*, formed under certain cultural conditions. Chains are rather long, unbranched. Cells sometimes knobbed and irregular in outline. Cohn says it is synonymous with his "torula-form."

Myxobacter: Thaxter, 1892.

Bot. Gaz., v. 17, No. 12, p. 403, 1892. See also idem, 1897, v. 23, p. 395. Rods forming large rounded cysts, one or more free within a gelatinous matrix raised above the substratum.

Type species (monotypy).—*M. aureus*. Pl. 25, figs. 34–36. Colonies when rising to form cysts are milky white. Rods large, cylindrical, rounded at either end, 4 to 7μ by .7 to .9μ. Cysts spherical or oblong, golden yellow, thick-walled, 1 to 12 or more in number distinct within a hyalin matrix 75 to 350μ by 75 to 275μ. The encysted rods are mingled with a yellow, oily material. Cyst groups are .7 to 1 mm. long. Hab.: On very wet wood and bark in swamps, Kittery Point, Me., and Belmont, Mass.

Myxobacterium: Faull, 1915.

Science, n. s., v. 42, N. Y., 1915, p. 469.

"A new Myxobacterium." (Does he refer to Thaxter's genus, *Myxobacter?*). The organisms heap up forming a stalked, branched, or unbranched, 1 to several headed fruiting body. On the heads columnar or conical cysts develop, on the surface of which a membrane is secreted. From these cysts the bacteria later migrate into the main body of the head, the husks of the cysts persisting as shriveled and twisted curls. Species remarkably variable in its morphology. Highly specialized.

Myxobazillus: Gonnerman, 1907.

See reference for *Myxokokkus*, p. 883.

Type species (monotypy).—*M. betae*. Slender rods, .3μ thick, 2.3 to 4.5μ long, often in twos or more, when they may be variously bent and curved. Easily stained with anilin dyes. No capsule. Nonmotile. Oval spores formed. Hab.: The sap used in the manufacture of sugar.

Myxobotrys: Zukal, 1896.

Ber. d. d. Bot. Gesellsch., v. 14, Berlin, 1896, p. 346. Places it among the Myxomycetes. Buchanan in J. Bact., v. 3, Balto., 1918, p. 542, says it is synonymous with *Chondromyces*. Spores in knoblike clusters on the widened out end of a simple or slightly branched sporophore or on a thin hypothallus or on the substratum.

Type species (original designation).—*M. variabilis*. Plasmodium flesh red, sporophore cylindrical, 1.4 to 1 mm. high, 20–30μ thick, yellowish and reddish transparent; knoblike end about 70μ wide and 40–50μ high. Spores about 20μ by 11–12μ, single on pointed end, yellowish or reddish in color and oval elliptical. The divided sporophores are botrytislike.

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Myxococcus: Thaxter, 1892.

Bot. Gaz., v. 17, No. 12, 1892, p. 403. See also idem, v. 23, 1897, p. 395. Rods slender, curved, swarming together after a vegetative period, to form definite, more or less encysted, sessile or stalked masses of coccus-like spores.

Type species (first in order of arrangement and according to author most common species).—*M. rubescens.* Rod masses reddish, rods slender, irregularly curved, 3 to 7μ by .4μ. Spore masses scattered, droplike, flesh colored to dull orange. Deep crimson when dry; at first coherent, becoming deliquescent; 150μ to 1 mm. in diam., often confluent; spores round, 1.5 to 1.2μ in diameter. Habitat: On various decaying substances, lichens, paper, dung, etc. Includes here also: *M. virescens*, n. sp.; *M. coralloides*, n. sp.; *M. simplex*, n. sp.

Myxokokkus: Gonnerman, 1907.

Osterreichisch-Ungarische Zeit. f. Zuckerindust. u. Landw., v. 36, Vienna,. 1907, p. 877. A "gelatin-forming Streptokokkus." The cocci are somewhat angular, and often 12 to 16 membered chains are found. Arthrospores. Involution forms.

Type species (monotypy).—*M. betae.*

Neisseria: Trevisan, 1885.

Atti della Accad. fisio-medico-statis. in Milano, ser. 4, v. 3, 1885, p. 105. See also Saccardo, Sylloge Fungorum, 8, 1889, p. 1067. Cocci primitus globosi indivisi, aetate provecta in coccos duos biscoctiformiter geminos, latere fraterem versus plus minus complanato, utrinque ad polos isthmis filamentosis tenuissimis insimul nexos, scissi, nunquam in turmas racemiformiter consociati. Endorsporae microsomae, in coccis normalibus obvenientes.

Type species (monotypy).—*N. gonorrhoeae.* Coccis biscoctiformiter geminis, 0.8 to 1.6μ, hyalinis.

Nevskia: Famintzin, 1891.

Bull. de l'Acad. Imp. des Sci., ser. 4, St. Petersburg, 1889–1892, p. 481. A branched "stiele," and around the outer edge of each branch are enclosed rodlike bacterial cells. Colonies result by the free rodlike organisms secreting a gelatinous material with production of the "stiele." The cells multiply by transverse division. Colonies variously shaped.

Type species (monotypy).—*N. ramosa.* Superficially like *Pasteuria ramosa.*

Newskia: Variant of Nevskia.

Nitrobacter: Winogradsky, 1892.

Arch. de Sci. Biol., pub. by l'Inst. Imp. de Med. Exper., St. Petersburg. 1892, v. 1, p. 87. Rodlike organisms, nonmotile, oxidizing nitrites to nitrates.

Type species (subsequent designation by Com. Soc. Am. Bact., in J. Bact., v. 2., no. 3, 1917, p. 552).—*N. winogradskyi* Committee. Description that given by Winogradsky, who named no species.

Nitromicrobium: Stutzer and Hartleb, 1901.

Mitt. d. Land. Inst. d. Breslau, v. 1, Berlin, 1901, p. 197. *N. germinans.* Oval, and at times drawn out (and with a sort of bud attached) rods. Both ends are never pointed. 1.5 to 2.5μ long by 0.6 to 0.8μ broad. Nonmotile. (Authors think this organism, and their *Hyphomicrobium*, belong in a special group among the microorganisms, probably not with the bacteria.)

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Nitrosobacterium: Rullmann, 1897.

Centralbl. f. Bakt., Abt. 2, v. 3, 1897, p. 228.

Type species (monotypy).—*N. formae novae.* Small, thick, approximately isodiametric short rods. A nitrite former. Nonmotile. Single or in chains. Polar staining. Branched threads occur in liquid media.

Nitrosococcus: Winogradsky, 1892.

Arch. d. Sci. Biologiques, pub. by l'Inst. Imp. de Med. Exper., St. Petersbourg, 1892, v. 1, p. 87. Organisms which convert ammonia into nitrites, and isolated from the "soils of the new world." Cocci about 1.5 to 1.7μ in diam. Apparently capsulated, nonmotile. No zoogloeae in liquid media.

Nitrosococcus: (Winogradsky) Buchanan, 1918.

J. Bact., v. 3, No. 2, Baltimore, 1918, p. 180.

Type species (original designation).—*N. americanus.*

Nitromonas: Winogradsky, 1890.

Ann. de l'Inst. Past., v. 4, Paris, 1890, p. 258. Cells ellipsoidal, more or less elongated, the young cells nearly spherical. 0.9 to 1.0μ by 1.1 to 1.8μ. Sometimes among the oval cells one finds others in the form of spindles, with blunt ends, and exceptionally this form is the dominant one. Cells usually nonmotile or only very slightly so, but at times they show active motility. Division occurs perpendicularly to the long axis. Chains of 3 to 4 individuals rare. No filaments nor spores. Zoogloeae. A nitrifying soil organism. Syn. (Buchanan in J. Bact., v. 3, No. 2, Baltimore, 1918, p. 180) *Nitrosomonas* Winogradsky.

Nitromonas: Jensen, 1909.

Cent. f. Bakt., Abt. 2, v. 22, 1908–9, p. 312. Renames *Nitrobacter* Winogradsky. Nonmotile short rod.

Nitrosomonas: Winogradsky, 1892.

Same reference as for Nitrosococcus, p. 87. See also Ann. de l'Inst. Past., v. 4, Paris, 1890, p. 258. Organisms from the old world which occur in soil and are capable of transforming ammonia into nitrites.

Type species (monotypy, and subsequent designation, Buchanan, J. Bact., v. 3, No. 2, Baltimore, 1918, p. 180).—*N. europea.* Syn. (Lehmann and Neumann) *Bact. nitrosomonas.* Cells elliptical and short.

Nocardia:[1] Trevisan, 1889.

Gen. e Spec. delle Batteriacee, 1889, p. 9. According to Saccardo's Sylloge Fungorum, v. 8, 1899, p. 927. Filamenta tenuissima, evaginata, articulata, Cladotricis more pseudoramosa, nunc e nucleo firmo radialiter expansa, nunc varie coalita. Arthrosporae in filamentis normalibus obvenientes, transformatione cocci singuli ortae. Est Cladothrix sine vaginis. Syn. (Trevisan) *Streptothrix* Cohn; *Actinomyces* Hartz, *Discomyces* Rivolta.

Species.—*N. farcinica* Trevisan: Glomerulis minutis, e filamentis intricatis, inextricabilibus numerossimis, e puncto centrali opaco radiantibus, pseudodichotomis, et in Cladotrice, cylindricis, 0.8 to 1μ latis; arthrosporis ovalibus. Hab. In farcino bovino in Gallia, nunc rarius, in ins. Guadelupa frequenter. Also includes here: *N. actinomyces* Trevisan, *N. foesteri* (Cohn) Trevisan, *N. arborescens* and *N. ferruginea.*

[1] Merrill and Wade (P. J. Sci., v. 14, No. 1, Jan., 1919, p. 59) state that De Toni and Trevisan's description of *Nocardia* as exhibiting false branching is incorrect, for although Nocard had originally so described his "bacille de farcin" Metchnikoff had found that it was a true branching organism. See *Discomyces.*

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Nodofolium:[1] Ellis, 1908.

Proc. Roy. Soc. Edinburg, v. 28, Pt. 5, 1908, p. 389.

Type species (monotypy).—*N. ferrugineum.* Belongs to the iron bacteria. A flat band, constricted at regular intervals. At the constricted points the individuals are slightly humped—giving an arch. Varies greatly in size, depending upon number of loops. An individual of 2 loops 10μ long by 0.75 to 1.5μ. Others may have as many as 12 loops, each about 10 to 12μ long. Reproduces by formation of a large number of conidia formed in same way as those of *Leptothrix ochracea.*

Nosema: Naegeli, 1857.

Amtlicher Bericht über die drei u. dreissigste versamml. Deutsch. Naturf. u. Arzte z. Bonn, Sept., 1857, p. 133. See also Bot. Zeit. v. 15, 1857, p. 760.

Type species (monotypy).—*N. bombycis.* Causing "*pebrine*" of silk worms. Small, elongated or oval cells, single, colorless, staining brown with iodine. Belongs near *Umbina aceti.* Syn. (Cohn, Schröter, Woodhead, et al.) *Panhistophyton ovatum* Lebert.

Octopsis: Trevisan, 1884.

Atti d. Accad. Fisio-med.-Statist. in Milano, ser. 4, v. 3, 1883–1885, p. 102. Trevisan states here that he provisionally placed in this genus his *Bact. cholerae-gallinarum,* and Zopf's *Micrococcus cholerae-gallinarum.* He also included in this genus the cause of typhoid in horses: *Octopsis equorum* (*Bact. equorum* Trevisan). See *Pasteurella.*

Oenobacillus: Forti, 1901.

Ann. d. Soc. Chim. di Milano, v. 3, 1901, Fasc. I. Accord. to Centralbl. f. Bakt. Abt. 2, v. 8, 1902, p. 500.

Type species (monotypy).—*Oenobacillus albae.* Polymorphic; at first diplococcus-like, then rod-shaped, with one end rounded, and usually in pairs. Nonmotile. Causing "sick" wine.

Oospora: (Wallroth, 1833) Sauvageau and Radais, 1892.

Ann. Inst. Pasteur, v. 6, 1892, 242. They place in this fungus genus *Streptothrix* Cohn, and the *Actinomyces* of Harz. *O. bovis* (Hartz).

Ophidomonas: Ehrenberg, 1838.

Die Infusionsthierchen als volkommene Org., 1838, p. 43. Animal e familia cryptomonadinorum, ocello destitutum, lorica obtusa, nuda, statura filiforme et divisione spontanea transversa perfecta.

Type species (monotypy).—*O. jenensis.* O. corpore spiraliter curvato tenuissimo, utroque fine aequaliter obtuso, 48 vam lineae $\frac{1}{2}$ mm.) parten longo, olivaceo fuscente. Quite similar to *Spirillum.* Found in a basin of water "bei der Kirche des Dorfes". Buchanan (J. Bact., v. 3, No. 5, 1918, p. 471) states that this genus is synonymous (?) with *Thiospirillum.*

Ophyrothrix: Borzi, 1878.

Nuovo Giorn. Bot. Ital. (Caruel), 10 (old series), Pisa, 1878, p. 274. Separates the species of Leptothrix, placing those attached by a single extremity of the very slender delicate filaments to the body of the other plant in this genus.

Species.—*O. thuretiana,* and *O. investiens.* Trevisan (Sacc. Syllog. Fung. v. 8, 1889, p. 933) states that this genus is synonymous with his *Leptotrichia,* and he renames *O. thuretiana: L. thuretiana.*

Oscillaria leptomitiformis: Meneghini (Ragazz. Nuov. ric. fis-chim., prior to 1842, p. 122). Trevisan says this species is syn. with his *Beggiatoa leptomitiformis.*

Oscillaria alba Vaucher (Hist. d. Conferv., 1803, p. 198) Zopf states it is syn. with *Beggiatoa alba.*

Bos. Bory, Dict. Class. 1. p. 594, and v. 12, p. 457—Kützing (Sp. Alg., p. 237) *Oscillatoria* (Vaucher). (Algae.)

[1] See footnote under *Leptothrix.*

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Oscillospira: Chatton and Pérard, 1913.

Compt. Rend. Soc. Biol. no. sp., v. 74, Paris, 1913, p. 1159.

Type species (monotypy).—*O. guilliermondi* n. sp. (Authors in doubt as to its systematic position. In structure it would seem to belong near *Arthromitus Saprospira, Pseudospira, Cristispira*, etc.) Found in the coecum of the guinea pig. Colorless, motile filaments containing endospores. Filaments measure 5μ in width up to 100μ in length. Rounded ends. Interior arranged in compartments of 1 to 2μ in length. Thickness varies. Cytoplasm homogeneous and finely granular, without pigment or sulfur granules—no inclusions of any sort. The filaments multiply by transverse fission. The sporulating filaments are never numerous. Spores ellipsoidal, and measure from 2.5μ wide by 4μ long.

Pacinia: Trevisan, 1885.

Atti della Accad. fisio-med.-statis. in Milano, 4 ser., v. 3, 1885, p. 84. Three stages of development: (1) Bacilli, (2) filaments, (3) cocci. The bacilli (typical protoplasmic state) are cylindrical, more or less curved, inarticulate, uncolored, of two forms: long and short; cytoplasm homogeneous. The filaments are irregular, flexuous, variously bent and curved. The cocci are derived from the microbacilli, at first in short chains, finally free. Spores.

Species—P. cholerae-asiaticae. Syn. (Trevisan) *Vibrio cholerae* Pacini, 1854; *Spirillum cholerae-asiaticae* Zopf, etc.

Palmella: Lyngbye, prior to 1849.

Defined it as an alga. Bacteria have been erroneously included here, e. g., *P. mirifica* Rabenhorst, which Trevisan states is synonymous with *Micrococcus mirificus* Trevisan. Schröter states also that *Pal. prodigiosa* Montagne is synonymous with *Monas prodigiosa* (Ehrenberg) Perty, *Micrococcus prodigiosus* (*Bact. prodigiosus* Ehrenberg) Lehmann and Neumann.

Panhistophyton: Lebert, 1856.

Jahresb. über die Wirksamheit d. vereins z. Beförd. des Seidenb. d. Prov. Brandeng. 1856–57, p. 28. According to Frey and Lebert: Vierteljahrssch. d. Naturforsch. Gesellsch. in Zürich. Zürich, 1856, p. 374. Oval, one-celled bodies; about twice as long as broad; end parts usually rounded; very definite contour. Size rather uniform. Length about 0.004 mm. to 0.005 mm., at most 0.006 mm. by 0.0025 mm. broad. Oscillatory motion.

Type species (monotypy).—*P. ovatum.* Syn. (Miller, Schröter, et al,) *Nosema bombycis* Nägeli. Causing "pebrine" of silk worms.

Parachromatium: Beijerinck, 1903.

Arch. Néerl. Sci. Ex. et Nat. Sér. 2, v. 7, La Haye, 1903, pp. 197 and 216. He gives this name as a synonym for his genus *Azotobacter:* "Peut-être le nom de Parachromatium, qui indique la parenté de notre microbe avec le genre *Chromatium* de M. Winogradsky, serait-il préférable. Des considérations physiologiques m'avaient d'abord conduit à une tout autre opinion, mais des études ultériques me portent à croire que cette parenté générique est indubitable."

Species.—P. (*Azotobacter*) *chroococcum* Beijerinck and *A. agilis* Beijerinck.

Paracloster: Fischer, 1895.

Jahrb. f. wissensch. Bot., v. 27, Berlin, 1895, p. 141. Nonmotile, without flagella, with endospores in spindle-shaped swollen-up rods. The spore often lies exactly in the center; it may lie in one of the ends.

Type species (monotypy).—*P. butyricus*, which he states (Vorlesungen über Bakt., 2 Aufl., Jena, 1903, p. 60), is syn. with *Granulobacter immobilis* Schattenfroh u. Grasberger.

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Parameningococcus: Dopter, 1909.

Compt. Rend. de la Soc. Biol., 67, Paris, 1909, p. 74. Not defined by him as a genus, although the authorship has been ascribed to him. He wrote "para-meningocoques," using the term for a special "race" of the Meningococcus which, by absence of specific agglutination and the existence of coprecipitins, he distinguishes from the Weichselbaum *Diplococcus.*

Paraplectrum: Fischer, 1895.

Reference as for *Paracloster.* Rods, nonmotile, without flagella, with endospores in a headlike swollen end.

P. peroniella (*Bacillus peroniella* Klein 1889).

Paraspirillum: Dobell, 1911.

Arch. f. Protistenk., v. 24, 1911, pp. 97, 1 pl., 7 figs.

Type species (monotypy).—*P. vejdovskii.* Body like that of *Spirillum,* but flexible. Contains a nucleus centrally located visible in living organism, and of round, oval, square, or oblong form, often occupying whole width of the organism. Nucleus homogeneous usually, and staining deeply. Karyosome observed in some nuclei. Usually two very delicate flagella present, one at either end. Measures in length 8 to 25μ by 1.5 to 2μ across middle portion. Many highly refractive metachromatic granules (volutin) in cytoplasm surrounding nucleus. Motile in screwlike manner in either direction, and in a circular manner with one end—the other being fixed. Habitat: Found in a culture of fresh water Cyanophyceae.

Pasteurella: Trevisan, 1887.

Sul Micrococco d. rabbia, 1887, p. 7. Gen. e Spec. d. Batt., 1889, p. 21. According to Saccardo's Syllog. Fung., v. 8, 1889, p. 994. Baculi plasmate polari-diblastico foeti. Sporue (arthrosporae?) isosomae, microsomae. Syn. (Trevisan) *Coccobacillus* Gamaleïa, 1888.

Trevisan's original paper is not available, but judging by dates and comparisons he uses in Saccardo, it is probable that the first type studied by him was *P. cholerae-gallinarum.* Buchanan (J. Bact., v. 3, No. 1, 1918, p. 51) gives the type species as *P. cholerae-gallinarum.* Trevisan includes 18 species in his paper in Saccardo's Sylloge Fungorum (v. 8, 1889, p. 994). He gives the synonymy of *P. cholerae-gallinarum* as follows: *Coccobacillus avicidus* Gamaleïa, 1888; *B. cholerae-gallinarum* Flügge; *Bact. cholerae-gallinarum* Schröter, 1886.

Pasteuria: Metchnikoff, 1888.

Ann. de l'Inst. Pasteur, v. 2, No. 4, Paris, 1888, p. 165. An organism parasitic upon *Daphnia pulex* and *D. magna.* Characterized by longitudinal division. Young colonies appear more or less rounded, and are formed of cauliflowerlike masses—that is, there is a central trunk which is dichotomously branched; the branches are easily detached and gradually dissolution of all the members of the primitive colony is brought about and new colonies are formed. The detached bacteria resemble somewhat the genus *Clostridium*—that is, adult forms have one large rounded end, the other being pointed (point of attachment). The isolated cells produce endospores. Methylene blue staining reveals three distinct portions of the cell—anterior, middle, and pointed end (dividing end). The spore is formed in the anterior portion.

Type species (monotypy).—*P. ramosa.*

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Pectinobacter: Makrinov, 1916.

Arch. d. Sci. Biol. de Petrograd, v. 18. No. 5, 1916. pp. 440–452. See also Bull. l'Inst. Past., Paris, Jan., 1917, p. 5.

Type species (monotypy).—*P. amylophilum*. Rods 4 to 6μ long by 0.5 to 1μ wide. Motile. Spores are formed, prior to which a fusiform aspect is assumed. Gram positive. Grows better on starch media than on any other. Active fermentative agent. Isolated from soil.

Pectobacillus? Jensen, 1909.

Centralbl. f. Bakt., Abt. 2, v. 22, 1908–9, p. 342. Pectin-fermenting group of peritrichiate rods. Stain blue with iodin usually. Liquefy gelatin. Obligate anaerobes.

Pediococcus: Balcke, 1884.

Wochenschr. f. Brauerei, 1884, p. 183.

NOTE.—Balcke's paper is not available; Lindner in the references cited below states that he is following Balcke. Trevisan (Saccardo's Syllog. Fung., v. 8, 1889, p. 1050) cites *Pediococcus* Lindner.

Pediococcus: (Balcke) Lindner, 1887.

Die Sarcina-Organismen der Gährungsgewerbe. Diss., Berlin, 1888, p. 9. See also Centralbl. f. Bakt., v. 2, 1887, p. 340, and v. 4, p. 202, and Bot. Centralbl., v. 36, No. 43, p. 98. Globose or ovoid cocci in tetrads, that is, division in two directions.

Species.—*P. cerevisiae* Balcke. Globose, hyalin cocci 0.6 to 1.0μ in diameter, in regular tetrads. Habitat: In beer, malt, etc. Also includes here: *P. albus* Lindner.

Pediokokkus: Eisenberg, 1891.

Bakt. Diagnostik. Eisenberg, 1891, p. 25. Variant of *Pediococcus*.

Pedioplana: Wolff, 1907.

Centralbl. f. Bakt., Abt. 2, v. 18, 1907, pp. 9–26, 5 pls. A genus belonging to the Coccaceae. Individual cells motile by means of a flagellum, and measure 0.35 by 0.5 by 0.75μ. Division in two directions—"Merismopedienbildung."

Type species (monotypy).—*P. haeckeli*. Found in decaying turnips.

Pelochromatium: Lauterborn, 1913.

Zur Kenntniss einiger sapropelischer Schiz. Allg. Bot. Zeitschr. f. Syst., v. 19–20, 1913, No. 7–8, p. 99.

Type species (monotypy).—*P. roseum*. Places it under the "*Rhodobakteriaceae*." Morphologically like *Chlorochromatium*. Distinguished only by the presence of bacteriopurpurin.

Pelodictyon: Lauterborn, 1913.

Allg. Bot. Zeitschr. v. 19–20, No. 7–8, Karlsruhe, 1913, p. 98. Places it under his new family *Chlorobakteriaceae*.

Type species (monotypy).—*P. clathratiforme* (*Aphanothece clathratiformis* Szafer.) Stretched out cells 0.002 to 0.003 mm. long. Yellow-green. Usually united into netlike bands, similar to *Thiodictyon* Winogradsky.

Pelogloea: Lauterborn, 1913.

Reference as for *Pelodictyon*, p. 99.

Type species (monotypy).—*P. chlorina* nov. gen. nov. spec.; yellow-green cells 0.003 to 0.004 mm. long, in chainlike threads embedded in a gelatinous mass. Colonies up to 1 mm. in diameter. Places it under his new family *Chlorobakteriaceae*. Found in decaying pond weeds.

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Peloploca: Lauterborn, 1913.

Reference as for *Pelodictyon*, p. 99. Colorless, threadlike cell-series, united into bands or bundles. Contain pseudovacuoles. Nonmotile.

Type species.—*P. undulata* Lauterborn. Cell threads, loosely spirally wound, united into a wavy, parallel-striped bundle. Single cells measure 0.006 to 0.010 mm. The bundles 0.06 to 0.15 mm. long. *P. taeniata* Lauterborn. Rather broad cell threads, often united into bands, through which the pseudovacuoles of the single cells appear as if latticed. Cells 0.003 to 0.004 mm. long. The bands up to 0.7 mm. long. Often found in the rotten slime of Characeae.

Pelosigma: Lauterborn, 1913.

Reference as for *Pelodictyon*, p. 100.

Type species (monotypy).—*P. cohnii* (Perty) Lauterborn. Perty placed his *Spiromonas cohnii* among the flagellates.

Pelosphaera: Lauterborn, 1906.

Allg. Bot. Zeitschr. v. 12, No. 12, 1906, p. 196.

Type species (monotypy).—*P. rotans* nov. gen. nov. sp. Cells wedge-shaped, in front broadened and rounded off, with rather firm membrane and granular content. United into mulberrylike spherical to elliptical colonies. Motile by means of flagella. Young colonies are colorless, older ones yellow-brown. Single cells sometimes enlarge, containing interiorly a conspicuous, strongly light refracting spherical body (spore?). Diameter of a colony 0.015 to 0.040 mm. Multiplication observed only in division of colony. Habitat: Decayed pond weeds.

Peptonococcus: Jensen, 1909.

Centralbl. f. Bakt., Abt. 2, v. 22, 1908–9, p. 340. Peptonizing, lactic-acid forming cocci.

Perroncitoa: Trevisan, 1889.

Gen. e Spec. delle Batt., 1889, p. 29. According to Saccardo's Sylloge Fungorum, v. 8, 1889, p. 1053. Cocci compressi, lateraliter duo per duos seriati (diplococci transversales) in filamenta simplica, vaginis cylindricis membranaceo-gelatinosis obducta concatenati. Arthrosporae macrosomae in filamentis obvenientes. Cocci e vagina liberati exacte globulosi fiunt.

Type species (monotypy).—*P. scarlatinosa.* Habitat: In infantibus scarlatinosis.

Petalobacteria: Billroth, 1874.

Untersuch. über die Vegetationsformen von Coccobacteria septica, Berlin, 1874, p. 16. Platelike masses forming on the surface of liquids. The individual rods are united by a gelatinous substance.

Petalo-Gliabacteria: Billroth, 1874.

Reference as for *Petalobacteria*, p. 17. Formed through the confluence of the homogeneous membrane of the Gliabacteria. At first without motion, later motile. See *Coccobacteria.*

Petalococcos: Billroth, 1874.

Reference as for *Petalobacteria*, p. 6. The gelatinous membranes of the single little spheres melt into each other, forming slimy plates.

Pfeifferella: Buchanan, 1917.

Abstract presented to the Soc. Am. Bact., Dec. 28, 1917. See also J. Bact., v. 3, No. 1, Jan., 1918, p. 54. Under the family *Bacteriaceae.* Nonmotile rods, slender, Gram negative without spores, staining poorly sometimes forming threads and showing a tendency toward branching. Gelatin may be slowly liquefied. No carbohydrates formed. Growth on potato characteristically honeylike.

Type species (original designation).—*P. mallei*, the cause of glanders.

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Photobacillus: Miquel and Cambier, 1902.

Traité de Bact. Paris, 1902, p. 881. Syn. Kat's light producing bacillus (Centralbl. f. Bakt., 1891, v. 9, p. 159). No species named—three species described by number.

Photobacter: Beijerinck, 1900.

Arch. Néerl. d. Sci. Ex. et Nat., ser. 2, v. 4, 1900, p. 6. A "genre physiologique." Apparently he uses this term interchangeably with his *Photobacterium.*

Species.—P. splendidum.

Photobacterium: Beijerinck, 1889.

Arch. Néerl. d. Sci. Ex. et. Nat., v. 23, 1889, p. 401. Light producing organisms (when grown in 3.5 per cent salt solution). Photogenic power lost by the addition of 2.5 per cent glucose. Grow best in a neutral or slightly alkaline solution—a trace of acid inhibits the formation of light.

Type species.—P. phosphorescens. Nonliquefying luminous bacteria of phosphorescent fish. *P. luminosum* Beijerinck; very small, resembling the cholera vibrio, but occurs also as short rods as well as spirals and short vibrios. *P. indicum:* Syn. (Beijerinck) *B. phosphorescens* Fischer. *P. fischeri.* Beijerinck states that all 4 species are so polymorphic that it is impossible to place them generically by means of their morphology, hence he uses physiological characters.

Photobakterium: Kruse, 1896.

Flügge: Die Mikroorganismen, v. 2, 1896, p. 333. Variant of *Photobacterium.*

Photospirillum: Miquel and Cambier, 1902.

Traité de Bact., Miquel and Cambier. Paris, 1902, p. 888. These authors name the vibrio described by Dunbar in Deutsch. Med. Woch., 1893, p. 799.

Species.—P. dunbari. Photogenic. Finest light is produced at 22° on gelatin prepared from peptonized beef bouillon. Pathogenic for guinea pigs.

Phragmidiothrix: Engler, 1883.

Vierter Bericht der Commission zur Wissenschaftlichen Untersuchung d. deutsch. Meere, in Kiel, 1883, p. 187. Filis rectis vel leviter flexuosis, gelatinosis, cellulis brevibus egranulosis.

Type species (monotypy).—*P. multiseptata.* Cellulis brevissimis, saepe diametro diversis, multis semel vel pluries septatis.

Phytobacter: Groenewege, 1912.

Meded. van de Rijks Hoog. Land-, Tuin- en Boschbouwschool, Deel v. 5, Afl. 5, Wageningen, 1912, p. 217.

Type species (monotypy).—*P. lycopersicum.* Rods of varying length, 1.5 to 2.5μ by 0.5 to 0.7μ. No spores. Very slightly resistant to heat. Young cultures motile. Zoogloea in old cultures, which appear as a complex of rods bound together by a viscous slime. Found in decaying tomato fruits.

Phytomyxa: Schröter, 1886.

Krypt-Flora v. Schlesien, Cohn. v. 3, Breslau, 1885–1889, p. 134. Described this genus as a myxomycete, and placed here Frank's *Schinzia leguminosarum,* which Frank later placed among the bacteria under the name of *Rhizobium leguminosarum.* See *Rhizobium.*

Planococcus: Migula, 1894.

Arb. aus d. Bact. Inst. d. Tech. Hoch. z. Karlsruhe. v. 1, Heft. 2, 1894, v. 2, Karlsruhe, 1897, p. 236. Family *Coccaceae* Zopf, emend. Migula. Cells spherical, sometimes flattened at points of contact when united in twos or fours. Divides in 1, 2 or 3 directions—2 directions most common. Endospores rare.

Type species (monotypy).—*P. citreus* (Menge) Migula.

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Planomerista: Vuillemin, 1913.

Ann. Mycologici, 11, 1913, p. 523.

Type species (original designation).—*Micrococcus tetragenus mobilis ventriculi* Mendoza, 1889, which becomes *P. ventriculi.*

Planosarcina: Migula, 1894.

Reference as for *Planococcus.* Single cells spherical. Division in 3 directions. Motile by means of a flagellum.

Type species (first in order of arrangement).—*P. agilis* (Cohen) Migula.

Plectridium, Fischer, 1895.

Jahrb. f. wissensch. Bot., v. 27, Berlin, 1895, p. 147. Motile rods; peritrichiate flagella; endospores in headlike swollen end of the rods.

Type species (subsequent designation by Buchanan, J. Bact., v. 3, no. 2, Balto., 1918, p. 38).—*P. tetani* (Nicolaier) Fischer. The author includes here also *P. paludosum* n. sp., *P. tetani; Plectridium* des Rauschbrandes.

Plectrillum: Fischer, 1895.

Reference as for *Plectridium,* p. 144. Motile rods, with tufts of polar flagella. Endospores in headlike swollen end of the rods.

Plectrinium: Fischer, 1895.

Reference as for *Plectridium,* p. 142. Motile rods, with a single polar flagellum. Endospores as in *Plectrillum.*

Plennobakterium: Gonnerman, 1907.

Oesterr.-Ungar, Zelt. f. Zucker Ind. u. Landw. v. 36, Wien, 1907, p. 886. Belongs to the hay bacillus group. Nonmotile. Gram positive. Spores. Gelatin liquefied. Single rods measure 0.4 to 0.6μ wide, and 2.5 to 5μ long and longer. Ends rounded or finely pointed. Long threads are formed during rapid growth. Found in the air of the rooms in which sugar is manufactured.

Pleurococcus: Meneghini, 1842.

Monogr. Nostochinearum italicarum, Turin, 1842. An algal genus into which erroneously several species of bacteria have been placed: Trevisan says *Pl. beigelii* Küchenmeister and Rabenhorst is syn. with his *Chlamydatomus beigelii.*

Pleurospora: Trevisan, 1889.

Gen. e Spec. delle Batt., 1889, p. 22. According to Sacc. Sylloge Fungorum, v. 8, 1889, p. 1002. A subgenus of *Cornilia* Trevisan. Sporae macrosomae e latere protruberantes.

Pneumobacillus: Arloing, 1889.

Compt. Rend. de l'Acad. d. Sci., Paris, 1889, v. 109, pp. 428 and 459.

Type species (monotypy).—*P. liquefaciens bovis.* Cause of contagious peripneumonia of cattle. Facultative aerobe and anaerobe. Very short rods, sometimes subovoid in bouillon, which upon gelatin elongate and assume the regular form.

Pneumococcus:[1] Arloing, 1889.

Compt. Rend. de l'Acad. d. Sci., v. 109, 1889, p. 430. *P. gutta-cerei,* Arloing, *P. lichenoides,* and *P. flavescens.* All three species accompanying *Pneumobacillus liquefaciens bovis* in peripneumonia of cattle.

Pollendera: Trevisan, 1884.

De Toni and Trevisan, in Saccardo's Sylloge Fungorum, v. 8, 1889, p. 943, state that this genus is synonymous with *Bacillus* Cohn.

[1] *Pneumococcus* is widely used in literature for *Diplococcus pneumoniae,* but the earliest use of the name in binomial combination seems to be that given here.

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Polyangium: Link, 1795.

Dissert. Botanicae, 1795, pp. 42 and 65. Accord. Thaxter, Bot. Gaz., v. 17, 1892, p. 389, and v. 23, 1897, p. 395, and v. 37, 1904, p. 405. Motile, circularly moving rods which form large, rounded cysts, one or more free within a gelatinous matrix raised above the substratum.

Type species [subsequent designation (Buchanan, Thaxter)].—*P. vitellinum.* Quehl (Centralbl. f. Bakt., Abt. 2, v. 16, 1906, p. 17) describes this species: Rods arranged in spherical masses 100 to 300μ in size, surrounded by a golden yellow membrane. One to 8 and more of these cysts form a colony of 1 to 4 mm. embedded in a gelatinous mass. The rods in these cysts are 1.2 to 3μ long by 0.4μ broad. Thaxter says *Polyangium* and *Cystobacter* Schröter are synonymous. Buchanan (J. Bact., v. 3, No. 6, 1918, p. 542) states that *Polyangium* is synonymous with *Myxobacter* Thaxter.

Polybacteria: Van Tieghem, 1880.

Bull. Soc. Bot. de France, v. 27, Paris, 1880, p. 149. Colonies without a membrane, colorless, oval, composed of little rods arranged in all directions, dividing transversely, always in the same direction, often remaining in flexuous chains. *P. catenata*, as above. *P. sulfurea*, yellow rods, colonies round or polyhedral, dividing in two directions. Found on the surface of a liquid containing rotting beans.

Polycoccus: Kützing, 1841.

An algal genus into which species of bacteria have been erroneously placed.

Polycephalum: Kalchbrenner and Cooke, (Date—?)

According to Engler and Prantl: Die Natürlichen Pflanzenfam. 1 Teil, Abt. 1, Leipzig, 1900, p. 489. A fungous genus belonging to the Hyphomycetes. Buchanan (J. Bact. v. 3, No. 6, Baltimore, 1918, p. 542) says it is synonymous with *Chondromyces*. Type species (monotypy), *P. aurantiacum.*

Propionibacterium: Jensen, 1909.

Cent. f. Bakt., Abt. 2, v. 22, 1908–9, p. 337. Peritrichiate rods, which form propionic acid—belonging to the *Acidobacteriaceae* Jensen.

Proteus: Hauser, 1885.

Über Fäulnissbacterien und deren Beziehungen z. Septicämie. Gustav Hauser. Leipzig, 1885, pp. 12, 66. Cells rod-shaped, motile, of varying length and thickness; sometimes very short, sometimes long and slender. Single, in pairs, and in long threads. Facultative anaerobes. Involution forms. Colonies (especially on 5 per cent gelatin) show raylike, forked, and sausagelike outgrowths. Cause putrid decomposition of different organic substances.

Type species (original designation).—*Proteus vulgaris.* Usually slender thin rods, but also sometimes oval, 0.00042 to 0.00063 mm. long by 0.00094 to 0.00125 mm. broad. Polar staining with fuchsin or gentian violet. Actively motile. Gelatin liquefied. Zoogloeae. Hauser includes here also *Proteus mirabilis* Hauser, and *Proteus zenkeri* Hauser, separating them from *Proteus vulgaris* chiefly because of their action on gelatin, *P. zenkeri* not liquefying gelatin at all, and *P. mirabilis* much more slowly than *P. vulgaris.* He thinks they might be only varieties of *P. vulgaris.* See *Proteus* emended Wenner and Rettger, and also *Zopfius* Wenner and Rettger.

Proteus: (Hauser) emended Wenner and Rettger, 1919.

J. Bact., v. 4, No. 4, July, 1919, p. 335. Small colilike rods, 0.4 to 0.6μ by 1.2 to 2.5μ, with rounded ends; occurring singly, in pairs or in chains; gram-negative; no spores or capsules; actively motile by means of peritrichiate flagella; gelatin is usually liquefied rapidly, though this property

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may be entirely lost. When inoculated into the condensation water of agar slants the rapidly spreading growth eventually covering the entire surface is characteristic. Glucose, levulose, galactose, sucrose, glycerol, and occasionally maltose, are fermented, with production of acid and gas. Alkalinity is produced in litmus milk, followed by decoloration of the litmus and digestion of the casein. Widely distributed in nature, occurring in sewage, soil, stagnant pools, etc. The authors include here *Proteus vulgaris* Hauser and *Proteus mirabilis* Hauser. They separate the two species on the basis of carbohydrate fermentation, the former fermenting maltose with acid and gas production, the latter being unable to attack this disaccharide. They set aside the differentiating characters of Hauser, however. See *Zopfius* for *Proteus zenkeri*.

Proteus: Müller, 1786.
Animalculi Infusoria Fluviatilia et Marina. Havniae. 1786, p. 9. *P. diffluens*. Placed among the Infusoria crassiuscula. Stiles thinks this is probably an amoeba.

Proteus: Baker, 1752.
Polyg., According to Scudder, Gen. in Zool., 1882, p. 264.

Proteus: Roes, 1755.
Polyg., According to Scudder, Gen. in Zool., 1882, p. 264.

Proteus: Laur, 1768.
Rept., according to Scudder, Gen. in Zool., 1882, p. 264.

Proteobacter: Beijerinck, 1900.
Centralbl. f. Bakt., Abt. 2, v. 6, 1900, p. 195. Organisms causing the putrefaction of albuminoids.
Species.—*P. septicum* (Pasteur), *P. pseudopulcher* Beijerinck. Anaerobic.

Protococcus: Agardh, 1824.
Syst. Algarum, Lund, 1824, p. XVII. An algal genus. *P. roseo-persicinus* Kützing is syn. (Migula) with *Lamprocystis roseo-persicina*.

Pseudobacterium: Trevisan, 1888.
Rend. R. Ist Lombardo di Sci. Milano, Ser. 2, v. 21, 1888, p. 788.

Pseudodiplococcus: Bonôme, 1888.
Centralbl. f. Bakt., v. 4, 1888, p. 321.
Type species (monotypy).—*P. pneumonicus*. Oval cocci in pairs or short chains, often surrounded by a transparent capsule. Grows on gelatin. Pathogenic to guinea pigs. Found in pleuropericarditis and cerobrospinal meningitis.

Pseudomeningococcus: Elser and Huntoon, 1909.
Med. Res., v. 20, 1909, p. 384. Not used in a generic sense. "We have reserved this term for a group of organisms which can not be differentiated from the meningococcus excepting by serum reactions."

Pseudomonas: Migula, 1894.[1]
Reference as for *Planococcus*, p. 876. Cells of varying length, cylindrical, straight, never curved; division in but one direction; short threads sometimes; polar flagella. Endospores rare, but do occur in some species. Syn. (Migula): *Bactrinium* Fischer, *Clostrinium* Fischer, *Plectrinium* Fischer, *Arthrobactrinium* Fischer, *Bactrillum* Fischer, *Clostrillum* Fischer, *Plectrillum* Fischer, *Arthrobactrillum* Fischer.
Species (monotypy).—*Pseudomonas violacea* (Schroter, 1886) Migula.

[1] ...ion by Com. Soc. Am. Bact., in J. Bact., v. 2, 1917, p. 556, and idem, v. 5,

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Pseudorhizobium: Hartleb, 1900.

Chem. Zeit., v. 24, Cöthen, 1900, p. 887.

Type species (monotypy).—*P. ramosum.* An organism very similar to Frank's *Rhizobium leguminosarum*, but does not produce root-nodules.

Pseudosarcina:

This term has been used by many authors, who give authorship to Mazé, who used "pseudo-sarcine."

Pseudo-Sarcine: Mazé, 1913.

Compt. rend. de l'Acad. Sci., Paris, v. 137, 1903, p. 887. Spherical, arranged in more or less voluminous aggregations, of a muriform aspect. Found in a flask of water containing fermenting leaves.

Pseudospira: Trevisan, 1889.

Gen. e Spec. d. Batt., 1889, p. 23. According to Saccardo's Sylloge Fungorum, v. 8, 1889, p. 1018. A subgenus of *Pacinia.* Baculi curvi, non raro semicirculares, saepissime in filamenta undulato-flexuosa vel irregulariter pseudo-spiralia, nunquam vere spiraliter ut in Spirillieis torta, consociata.

Punctula: van Tieghem, 1880.

Bull. Soc. Bot. de France, v. 27, Paris, 1880, p. 150. Spherical cells, without membrane, which aggregate to form a "punctula." Usually very small—"innumerable points united by a gelatinous cement."

Species.—P. rosa. Colonies rose color, composed of cells arranged regularly in concentric circles, and in radial series. After each division the two halves of the colony grow and completely separate. *P. cubica:* "Grains" are slightly larger, and are colorless. Grouped in the form of a cube, which divides successively parallel to the three faces. *P. glomerata:* All three species found on putrefying plant parts.

Punctum: Mühlhäuser, 1884.

Virchow's Archiv., v. 97, 1884 p. 97, pl. 13, figs. 1–7. Very small (0.0005 mm.) of varied from, but usually oval; at first not motile, later very lively, moving around in a circular fashion. It can traverse 0.1 mm. in one second. In young cultures (stagnant water) the longer forms are found. No chains or filaments.

Type species.—Punctum saltans. Syn. (Trevisan, Saccardo's Sylloge Fungorum, v. 8, 1889, p. 1008) *Spirillum obermeieri* Cohn, 1875 (Beit. z. Biol. der Pflanzen, v. 1, p. 196).

Putribacillus: Jensen, 1909.

Centralbl. f. Bakt., Abt. 2, v. 22, 1908–9, p. 342. Peritrichiate rods, anaerobic, putrefactive.

Includes here: *Bacillus putrificus*, which becomes *Putribacillus vulgaris.*

Pyobacillus: Koppányi, 1907.

Zeit. f. Tiermed. v. 11, Jena, 1907, p. 448. Anaerobic, polymorphic, capsulated bacillus. Grows only at body temperatures and on albuminous media. Found in pleural exudate of dog.

Type species (monotypy).—*Pyobacillus capsulatus cuniculi* (*Bacillus capsulatus pyaemiae cuniculi*) n. sp. Com. Soc. Am. Bact., in J. Bact., v. 2, no. 5, 1917, p. 561, state that this genus is synonymous (?) with their *Hemophilus.*

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Pyobacterium: Küttner, 1895.

Zs. f. Hyg., v. 19, Heft 2, p. 263. See also Centralbl. f. Bakt., Abt. 1, v. 17, Jena, 1895, p. 760.

Type species (*monotypy*).—*Pyobacterium fischeri.* Synonymous (Küttner) with *Eiterbacterium.*

Pyococcus: Ludwig, 1892.

Lehrb. d. niederen Kryptog., 1892, p. 37. Used by Ludwig as synonymous with *Staphylococcus pyogenes.*

Rasmussenia: De Toni and Trevisan, 1889.

Saccardo's Sylloge Fungorum, v. 8, 1889, p. 930. Filamenta cylindrica, vagina tenui gelatinosa facile evanescente obducta, simplicia, basi subivulo zoogloeico affixa, articulata. Multiplicatio bacilis primitus vivaciter mobilibus, cito, immotis. Arthrosporae transformatione cocci singuli ortae.

Species.—Leptothrix gigantea (Miller). *L. buccalis* Robin and Lebert, *R. maxima* Trevisan; *R. anceps* Trevisan, *R. variabilis* (Rasmussen) Trevisan.

Rhabdochromatium: Winogradsky, 1888.

Beitr. z. Morph. u. Phys. d. Bact., Leipzig, 1888, Heft 1, p. 100, pl. 4. Cells rod-shaped or spindle-shaped, with polar flagella. Of varying length, usually rather long, S granules present. Cells free, capable of swarming at any time.

Species.—R. roseum. Syn. (Winogradsky) *Rhabdomonas rosea* Cohn. 3 to 7μ thick by 15 to 30μ long. Rose-red in color. *R. minus* Winogradsky and *R. fusiforme* Winogradsky.

Rhabdomonas: Cohn, 1875.

Beit. z. Biol. d. Pflanzen, Cohn. v. 1, 1870–75, p. 167. Cohn says he is following Ehrenberg, who called some of his "Stabmonaden" "Rhabdomonaden" (Die Infusionsthierch., 1838, p. 15) under which he puts *Monas okenii*, etc.

Type species (monotypy).—*R. rosea.* Spindle-shaped rose-red bodies, both ends of which are pointed. Sometimes 8 times as long as broad. Breadth 3.8 to 5μ by 20 to 30μ. Multiplication by transverse division. Contain highly refractive granules. A clear vacuole in the middle or end was observed. Motile by means of 1 flagellum.

Rhabdomonas: Jensen, 1909.

Centralbl. f. Bakt., Abt. 2, v. 22, 1909, p. 334. Renames *Rhabdochromatium* Winogradsky.

Rhizobacterium: Kirchner, 1895.

Beitr. z. Biol. d. Pflanzen, Cohn., v. 7, 1894–1896, Breslau, 1896, p. 221. Modifies *Rhizobium* Frank, because of the "Aphiden-Gattung von Burmeister den Namen Rhizobius erhalten hat, welcher bis jetzt in Geltung geblieben ist."

Type species (monotypy).—*Bacterium* (*Rhizobacterium*) *japonicum*, n. sp. Cells rodlike, mostly slightly curved, 3.2 to 3.6μ long by 0.8μ thick, with granular content. Not motile. Gelatin not liquefied. Habitat: In soil in Japan, and causing root-nodules on soy bean.

Rhizobium: [1] Frank, 1890.

Landw. Jahrb., v. 19, 1890, p. 563, 14 pls.

Type species (monotypy).—*R. leguminosarum:* Syn. *Schinzia leguminosarum* Frank. A micrococcus or short rod, at times motile. There are also zoogloeal forms and threadlike slimy masses. Can live saprophytically as well as parasit-

[1] See *Schinzia.*

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ically through its ability to assimilate organic nitrogen. Lehmann and Neumann (Atlas u. Grund. d. Bakt., part 2, Munich, 1904, p. 215) state that *Rhizobium radicicola* (Beijerinck) Hiltner and Störmer, 1891, is synonymous with *Bacterium radicicola* Beijerinck.

Rhizomonas: Jensen, 1909.

Centralbl. f. Bakt., Abt. 2, v. 22, 1908–9, p. 328. Polar flagellate obligate aerobes, capable of oxidizing carbon compounds, of reducing nitrates to nitrites, and in part also further to ammonia; assimilate atmospheric nitrogen. Renames the genus *Rhizobium*. Includes *R. beijerinckii* and *R. radicicola*.

Rhodobacillus: Molisch, 1907.

Die Purpurbakterien. Molisch, Jena, 1907, p. 14.

Type species (monotypy).—*R. palustris*. Short rods, 1.5 to 2.5μ long by 0.5μ broad. Rounded ends. Single or in chains of 2 to 4 individuals. Length varies with kind of media. Slightly motile. Contain bacteriopurpurin and bacteriochlorin. Free living.

Rhodobacterium: Molisch, 1907.

Reference as for *Rhodobacillus*, p. 16.

Type species (monotypy).—*R. capsulatum*. Short rods, almost coccuslike. 0.9 to 1.8μ long. On gelatin 0.9 to 2.7μ. Capsulated. Nonmotile. Contain bacteriopurpurin and bacteriochlorin. Free living in sea water.

Rhodocapsa: Molisch, 1906.

Bot. Zeit., Abt. 1, v. 64, 1906, pp. 221 and 232.

Type species (monotypy).—*R. suspensa*. Cells rod or sausage-like, both ends rounded. All gradations from short rods to rather long threads, 3.5 to 180μ long by 1.8 to 3.5μ wide. Average length 10 to 20μ. Usually capusulated, the colorless, homogeneous capsule measuring 3.6 to 18μ. Capsulated individuals motionless. Noncapsulated, actively motile. Sulphur granules or "airsomen" present. Bacteriopurpurin and bacteriochlorin also present.

Rhodococcus: Molisch, 1907.

Reference as for *Rhodobacillus*, p. 20.

Species.—R. capsulatus: Cocci 1.5 to 1.8μ. Capsule measures 3 to 3.6μ in diameter. Not motile. Bacteriopurpurin and bacteriochlorin present. Free living (hay and other infusions). *R. minor.*

Rhodococcus: Zopf, 1891.

Ber. d. deutsch. Bot. Gesellsch., v. 9, 1891, p. 28. Defines it as a subgenus of Micrococcus. Cells containing a red pigment. Irregularly grouped. No capsule.

Species.—R. erythromyxa (renaming *Micrococcus erythromyxa* Zopf) and *R. rhodochrous* Zopf.

Rhodococcus: [Zopf] em. Winslow and Rogers, 1906.

Biol. studies by the pupils of W. T. Sedgwick. Boston, June, 1906, p. 206. Saprophytes. Cells in groups or regular packets. Generally decolorize by Gram. Growth on agar abundant, with formation of red pigment. Dextrose broth slightly acid, lactose broth neutral. Gelatin rarely liquefied. Nitrates generally reduced to nitrites, but not to ammonia. The authors include here: *R. cinnabareus* Flügge; *R. roseus* Flügge; *R. fulvus* Cohn; *R. agilis* Ali Cohen; *R. incarnatus* Gruber.

NOTE.—Buchanan (J. Inf. Dis., v. 17, No. 3, 1915, p. 239) says that *Rhodococcus* Winslow and Rogers may be regarded as an emendation of *Rhodococcus* Zopf.

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Rhodocystis: Molisch, 1907.

Die Purpurbakterien, etc. Molisch, Jena, 1907, p. 22.

Type species (monotypy).—*R. gelatinosa*. Rods with rounded ends, narrowing somewhat toward the middle, 2 to 5μ by 0.6μ. Single cells or different sized groups surrounded by a gelatinous substance. Bacteriopurpurin and bacteriochlorin present. Found in standing water containing maple leaves, and in hay infusion.

Rhododictyon: Jensen, 1909.

Centralbl. f. Bakt., Abt. 2, v. 22, 1908–9, p. 330. Red sulfur bacteria, with pointed ends, motile.

Type species [by inclusion (see Buchanan, J. Bact., v. 3, No. 5, 1918, p. 469].—*R. elegans*. Renames *Thiodictyon* Winogradsky.

Rhodomonas: Jensen, 1909.

Centralbl. f. Bakt., Abt. 2, v. 22, 1908–9, p. 327. Bright red sulfur bacteria. Renames *Chromatium* Perty.

Rhodonostoc: Molisch, 1907.

Die Purpurbakterien, etc. Molisch, Jena, 1907, p. 23.

Type species (monotypy).—*R. capsulatum*. Cocci, or coccus-like rods, with rounded ends, single, in twos and short rosary-like chains. Capsulated. 1.4 to 2μ without capsule. Capsule 2.7 to 8μ by 21μ long. Not motile. Found in water containing rotting maple leaves.

Rhodopolycoccus: Jensen, 1909.

Centralbl. f. Bakt., Abt. 2, v. 22, 1909, p. 331. Renames *Thiopolycoccus* Winogradsky.

Rhodosarcina: Jensen, 1909.

Reference as above, p. 331. Renames *Thiosarcina* Winogradsky.

Rhodosphaera: Buchanan, 1918.

J. Bact. v. 3, No. 5, Sept., 1918, p. 472. Under subfamily *Rhodobacterioideae* Buchanan. (Syn. *Rhodococcus* Molisch.) Cells rod-shaped, nonmotile, free, not united into families.

Type species (original designation).—*R. capsulatus* (Molisch) Buchanan.

Rhodospirillum: Molisch, 1907.

Reference as for *Rhodonostoc*, p. 24.

Type species (subsequent designation by Buchanan in J. Bact., v. 3, No. 5, 1918, p. 473).—*R. rubrum* (Esmarch) Molisch. *R. photometricum:* Thick spirilla 5 to 13μ long by 1.4μ thick. Actively motile by means of a polar flagellum. Free living. *R. giganteum*: Longer and thinner than above.

Rhodothece: Molisch, 1906.

Bot. Zeit., Abt. 1, v. 64, 1906, p. 230 and 232. See also Die Purpurbakterien, Molisch, 1907, p. 19. Cells round, usually in pairs; nonmotile; contain S granules; cells surrounded by a colorless capsule. Red "airsomen" also present. Cells measure 1.8 to 2.3μ in diameter, the capsule 3 to 14μ.

Type species (monotypy).—*R. pendens*.

Rhodovibrio: Molisch, 1907.

Reference as for *Rhodonostoc*, p. 21.

Type species (monotypy).—*R. parvus*. Slightly curved, short rods, 1.6 to by 0.9μ broad. One long, wavy flagellum, rarely 2. Positively chemo- r dilute acids.

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Rickettsia: Da Rocha Lima, 1916.[1]

Berlin klin. Wochenschr., May 22, 1916, p. 567. According to Brumpt., Bull. Soc. Path. Exot., v. 11, No. 3, March, 1918, p. 253. Easily stained by Giemsa. Young individuals elliptical, short, almost globular. During division, biscuit-shaped. Measure 0.3 to 0.4μ. Da Rocha Lima considers his organism (Münch. med. Woch. v. 44, Jan., 1917, p. 33) identical with that found by Ricketts and Wilder.

Type species.—R. prowazeki. Cause of typhus exanthematicus.

Rickettsia: (Da Rocha Lima) emended Arkwright, Bacot and Duncan, 1919. J. Hyg., v. 18, no. 1, April, 1919, p. 76.

NOTE.—This should probably not be regarded as an emendation, but rather an amplified description. Since Da Rocha Lima's paper is not available it is impossible to determine this point.

Very small, 0.3 to 0.5μ by 1.5 to 2μ. Morphologically like a coccus, diplococcus or a short bacillus. Gram-negative. Not acid fast. Stains well by Giemsa, appearing as small dots, paired cocci or bipolar staining bacilli with an unstained central part. Not motile. Occurs sparsely in blood films. Not successfully grown on artificial media.

Prowazek regards this organism as a protozoon largely because it is insect borne, and Da Rocha Lima seems rather inclined to this view on account of its peculiar staining reactions. Arkwright, Bacot, and Duncan, however, regarded its Giemsa staining reactions as quite like those of other bacteria. They conclude: "Nevertheless this class of micro-organism and its associated diseases appear to have sufficiently distinct characteristics to justify the retention of the name Rickettsia for the present." They state that Da Rocha Lima found these bodies in the midgut of lice (*Pediculus humanus*) fed on trench fever patients, and that he considered the species causing typhus and trench fevers distinct. In typhus he claimed that the organism (*Rickettsia prowazeki*) invaded the epithelial cells of the gut wall, while only rarely is this the case with the trench fever organism (*R. quintana*), and with *R. pediculi* which is found in normal lice. He also claims that morphological differences are easily discernible if serial sections are cut. He infected a few guinea pigs, but was not able to pass the disease on from pig to pig, nor to infect mice.

Saccharobacillus: Van Laer, 1892.

Mem. Couron. et autres Mém. pub. par l'Acad. Royale d. Belgique, v. 47, 1892, pp. 1–37. Filiform bacillus, found in spoiled beer by Pasteur: Grows very slowly; ferments saccharose without previous inversion.

Type species (monotypy).—*Saccharobacillus pastorianus.*

Saccharobacter: Beijerinck, 1900 (?).

Centralbl. f. Bakt., Abt. 2, v. 6, 1900, p. 200. See also Arch. Néerl. sér. 2, v. 4, 1900–1901, p. 9. Aerobic, sugar fermenting bacteria. Includes *Bacillus megatherium* and *B. hortulensis.*

Salmonella: Lignières, 1900.

Bull. Soc. Centr. de Méd. Vét. n. s., v. 18, Paris., 1900, pp. 389 and 402. Cause of "hog-choléra de Salmon" or "schweinpest." Usually a very short rod, but in bouillon it becomes somewhat longer. Motile by means of peritrichiate flagella. Gram negative. No spores. Gelatin not liquefied. Pathogenic for rat, rabbit, etc. Buchanan (J. Bact., v. 3, No. 1, 1918, p. 53) makes this a subgenus of *Bacterium.*

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[1] See footnote under *Dermacentroxenus.*

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Saprospira: Gross, 1911.

Mitt. aus der Zool. Stat. z. Neapel, v. 20, Heft 2, p. 189. Places this genus under the *Spironemaceae* Gross. Spirally bent bodies. Multiplication through "Zerfallstheilung". Free living.

Species.—S. grandis n. sp. Average length of mature individual 100μ. Highest number of windings 15. Length of single windings 6 to 6.5μ. Thickness 0.8μ. Spores. Buchanan (J. Bact., v. 3, no. 4, 1918, p. 544) designates this species as the type.

S. nana. n. sp. Average length of mature individual 36μ. Highest number of windings 16. Length of single winding 2.25 to 3μ. Thickness 0.5μ. No spores.

Sarcina: [1] Goodsir, 1842.

The Edinburgh Medical and Surgical Journal, v. 57, 1842, p. 430, Pl. VII, figs. 2, 3. Plants coriaceous, transparent, consisting of 16 or 64 four-celled square frustules, arranged parallel to one another in a square transparent matrix. "It exhibits no mouths, no oral appendages, no visceral sacs, and its cells, instead of having the gelatinous appearance so familiar to the observer of the animal infusorials, are clear, transparent, as if empty, and have that consistency of wall characteristic of vegetable structure. Believing *Sarcina* to be a vegetable, I may state, in reference to its characters, that they are of a kind which distinguish it from all the gonioid plants at present known. * * * It makes the nearest approach to *Gonium hyalinum* which with *Gonium glaucum* and *G. tranquillum*, even Ehrenberg, himself, seems inclined to hand over to the botanists under the generic term *Gonidium.* The generic characters of *Sarcina* are to be found in the predominance of the constituent cells over the outer coat or lorica, in each frustule being four-celled, and in the entire freedom of these from all colored contents. Of the specific characters of a single species much can not be said."

Type species (monotypy).—*Sarcina ventriculi* Goodsir. Frustules 16; color light brown; transparent matrix very perceptible between the frustules, less so around the edges; size ".800 to .1000 of an inch" "The individual organisms were transparent and slightly yellow or brown. When carefully examined under favorable circumstances the cell walls appeared rigid, and could be perceived passing from one flat surface to the other as dissepiments. These dissepiments, as well as the transparent spaces, were from compression of contiguity rectilinear, and all the angles right angles; but the bounding cells bulged somewhat irregularly on the edges of the organism by reason of the freedom from pressure. These circumstances gave the whole organism the appearance of a wool pack, or of a soft bundle bound with cord, crossing it four times at right angles, and at equal distances." Found in the human stomach.

Sarcina: (Goodsir) emended Winslow and Rogers, 1905.

Science, n. s., v. 21, 1905, p. 669. See also J. Inf. Dis., 1906, v. 3, pp. 490, 545; The Systematic Relationships of the Coccaceae, Winslow and Rogers, New York, 1908, and Biol. Studies by Pupils of W. T. Sedgwick, Boston, 1906, p. 206. Faculative parasites or saprophytes. Division occurs under favorable conditions in three planes, producing regular packets. Generally decolorize by Gram. Growth on agar abundant, with formation of yellow pigment. Dextrose broth slightly acid; lactose broth generally

[1] *Sarcina* may lay claim to antiquity since it was the first genus defined as a and still retained among the bacteria.

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neutral. Gelatin frequently liquefied. Nitrates may or may not be reduced. They include here the following species: *S. ventriculi* Goodsir, *S. lutea*, *S. aurantiaca* Flügge, and *S. subflava* Ravenel, and *S. tetragena* (Mendoza) Migula.

Sarcinacoccos: Billroth, 1874.

Same reference as for *Coccos* Billroth. p. 8. See *Coccobacteria*.

Sarcinaglobulus: Poulsen, 1879.

Vidensk. Meddelelser fra Naturh. Forenink i Kjobenhavn, 1879–80, p. 232. Schizphytarum corpora perpava hyalina e cellulis incoloribus minimis composita formans. Cellulae plantae vivae vix conspicuae reagentibus chemicis additis apparent. Divisionis modus ut in Sarcina, quacum maximam similitudinem habet. Ab hoc genere eo differt, quod non fasiculos hexaedricos sed globulos vel flebas subisodiametricas vel irregulares rotundatas format. Nucleum cellularum non observati. Species adhus una cognita, scil.

Type species (monotypy).—*S. punctum*. Char. gen.: Magn. 2 to 200μ. In limo putido litoris freti cresund prope Haunias legi.

Sarcinastrum: Lagerheim, 1900.

Bihang till Kongl. Svenska Vet.-Akad. Hand. Afd. 3, No. 4, Stockholm, 1900, p. 9.

Type species (monotypy).—*S. urosporae*. Parasitic on Urospora spp. Polymorphic. Rod and coccus forms. The rod form goes over into the coccus form. Rods cylindrical with rounded ends, measure 4 to 5μ by 2μ, and divide by longitudinal division, thus forming very characteristic semispherical and spherical (hollow) colonies. When the colony has attained a certain size the rods begin dividing by cross division, producing the coccus form.

Schinzia: Frank, 1879.

Bot. Zeit., v. 37, 1879, p. 376. A mold genus into which Frank first placed his *Rhizobium leguminosarum*, designating it as *Schinzia leguminosarum*. Schroeter thought the organism a slime mold and formed the new genus *Phytomyxa* for it. Beijerinck named the organism *B. radicicola*. The committee on Classification of the American Bacteriological Society (J. Bact., v. 3, No. 1, Baltimore, 1918, p. 46) recommends that *Rhizobium* be used rather than *Phytomyxa*.

Schinzia: Dennstatt (Fungi), 1818.

Schinzia: Nägeli (Fungi), 1842.

Schmidlea: Lauterborn, 1913.

Allg. Bot. Zeitschr., v. 19–20, No. 6, Karlsruhe, 1913, p. 98. Places it under his new family *Chlorobakteriaceae*.

Type species (monotypy).—*S. lutcola* (*Aphanothece lutcola* Schmidle). Elliptical cells, yellow green, 0.0015 to 0.002 mm. long, united into roundish to oval, often gelatinous colonies, which sometimes enclose a vacuole-like space. Colonies usually 0.2 to 0.3 mm. in diameter.

Schuetzia: Trevisan, 1889.

Gen. e Spec. delle Batt., 1889, p. 29. According to Sylloge Fungorum, Saccardo, v. 8, 1889, p. 1052. Cocci globosi vel divisionis tempore ovoidei, in filamenta moniliformiter concatenati, capsulis membranaceo-gelatinosis, arctis, tenuiusculis, homogeneis, nonlamellosis obducta. Arthrosporae macrosomae in filamentis obvenientes.

Species.—*S. lagerheimii* (Ludw.), *S. laughlini* Trevisan, etc.

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Sclerothrix: Metchnikoff, 1888.

Virchow's Arch., v. 113, 1888, p. 70.

Type species (monotypy).—*S. kochii.* Renames *Bacillus tuberculosis* Koch. Bases his genus on the thread formation and dense envelope which this organism possesses.

Sclerothrix: Kützing, 1837.

Alg. aq. dulc., Dec. II, No. 27. Defined here as an alga, with *S. callitrichae* as the type species.

Semiclostridium: Maassen, 1905.

Arb. Biol. Abteil. f. Land. u. Forstw. am Kaiserl. Gesund. Heft 1, v. 5, 1905, p. 6.

Type species (monotypy).—*S. commune.* Aerobic rod, spore-forming, and according to Fischer's classification belongs to the subfamily *Clostridiaceae.* A cylindrical vegetative body, which appears to be slightly arched at the ends. Measures 0.75μ by 2 to 5μ. Widely distributed on roots, plant surfaces, etc.

Serratia: Bizio, 1823.

Polent. porporp. in Bibl. Ital. v. 30, 1823, p. 288. According to Trevisan, Rend. Reale Ist. Lomb. Ser. 2, 1897, pp. 12, 141.

Type species (according to Vuillemin, Ann. Mycol. v. 11, 1913, p. 518.)—*S. marcescens* Bizio 1827.

Serratia: (Bizio, 1823) emend. Vuillemin, 1913.

Ann. Mycol. v. 11, 1913, pp. 518, 523 and 525. In order to avoid a neologism he retains Bizio's name for rods provided with peritrichiate flagella, giving as the type species *S. subtilis* (*Vibrio bacillus* Müller,) *V. subtilis* Ehrenberg, *Metallacter bacillus* Perty, 1852, *Bacillus subtilis* Cohn.

Siderocapsa: Molisch, 1910.

Ann. d. Jard. Bot. de Buitenz., Suppl. 3, pt. 1, 1910, pp. 29–33. See also Die Eisenbakterien. Hans Molisch, Jena, 1910, p. 11.

Species—S. treubii. Belonging to the "kapselbakterien." Coccus-like, capsulated—1 to 8 often within one capsule, which is gelatinous, brownish. Cocci measure, 0.4 to 0.6μ. Bright ellipsoidal halo around the cocci, measures 0.1μ to 3.6μ, surrounding which is the iron oxide area, with a diameter of 5 to 18μ. Habitat: An epiphyte on the roots, root-hairs, and leaves of water plants. *S. major.*

Siphonomyxa: Billroth, 1874.

Reference as for Coccos Billroth, p. 27. Vegetative forms quite similar in size and form to *Coccobacteria septica*, that is: streptobacteria, gliacoccos, ascococcos, mycelial-like threads containing spores which develop into bacteria, etc. In mass the color is bright grayish yellow. *S. noscomii viennensis.*

Solidococcus: Jensen, 1909.

Centralbl. f. Bakt., Abt. 2, v. 22, 1909, p. 332. Polar flagellate cocci, not liquefying gelatin.

Solidovibrio: Jensen, 1909.

Reference as for *Solidococcus*, p. 333. Polar flagellate vibrios not liquefying gelatin. Reduce sulfates forming H_2S.

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Sphaerococcus: Marpmann, 1886.

Ergänzungsh. z. Cent. f. Allg. Gesundheitspflege, v. 2, Heft 2, Bonn, 1886, p. 121.

Type species (monotypy).—*S. lactis acidi.* A very small, oval coccus in twos and more, forming torula-like chains. Nonmotile. A milk fermenting organism.

Sphaerococcus: Agardh (exp. 1823), emend. Kützing, 1843.

Phyc. Gen., 1843, p. 408. An algal genus into which species of bacteria have been placed erroneously.

Sphaerokokkus: Eisenberg, 1891.

Bakt. Diagnostik, 1891, p. 50. Variant of *Sphaerococcus.*

Sphaerotilus: Kützing, 1833.

Linneae, v. 8, Berlin, 1833, p. 385, pl. 9. Kützing defined this genus as a fresh-water alga, but Migula (Syst. d. Bakt., v. 2, 1900, p. 1035) includes it among his *Chlamydobacteriaceae.* See also Buchanan, J. Bact., v. 3, no. 3, Balto., 1918, p. 303. Frons mucosa tenerrima fragillina filamentosa, filis paralleliter agglutinatis constituta fila e globulis hyalinis longitudinaliter dispositis, massae sporaceae mucosae ope conjunctis composita.

Type species (original designation).—*S. natans* Kützing. Frons lutescenti-fusca, plumosa, divisione ramosa. Trevisan says this species is syn. with *Leptothrix natans* Denaeyer.

Sphaerotilus (Kützing) em. De Toni and Trevisan, 1889.

Saccardo's Sylloge Fungorum, v. 8, 1889, p. 926. Filamenta premitus affixa, basi ab apice superiori distincta, initio simplicia, dein Cladotricis more pseudoramosa a basi ad apicem subaequilata, articulata, vagina gelatinosa obducta, in fasciculos crassos floccosos varie divisos consociata. Multiplicatio fragmentis filamentorum secedentibus, quae filamenta et fasciculos novos efficiunt. Arthrosporae numerosissimae, articulorum divisiones in tres directiones ortae.

Sphaerotilus (Kützing) em. Engler, 1903.

Syllabus der Pflanzenfamilien. ed. 3, p. 5. Engler placed *Streptothrix, Cladothrix, Actinomyces,* and *Nocardia* under the family Chlamydobacteriaceae, including all of these genera under the name *Sphaerotilus* Kützing.

Sphaerotilus: (Kützing) emend. Buchanan, 1918.

J. Bact., v. 3, no. 3, Baltimore, 1918, pp. 303 and 305. Filaments of rods or oval cells, attached, colorless, showing pseudodichotomous or false branching; multiplication by motile (swarm cells) and nonmotile conidia, the former with a clump of flagella near one end. Usually without a deposit of Fe_2O_3 in the sheath.

Type species (by inclusion).—*S. natans* Kützing.

Spirillum: Ehrenberg, 1830.

Abhandl. d. Konig. Akad. d. Wissensch. z. Berlin, and idem 1830 (1832) p. 38, and 1831 (1832), p. 68. See also Die Infusionsthierchen, etc., 1838, p. 84, pl. 5, figs. 11–13. Rigid spirals of screw-like form; cylindric; transverse division.

Species.—S. volutans. Syn. *Vibrio spirillum* Müller, 1786. Large spirals; amplitude 1/96 inch; body colorless, slightly transparent; spirals of 3 or many turns. This species is the type by absolute tautonymy according to Dr. C. W. Stiles (Bull. No. 24, Hyg. Lab., U. S. Treas. Dept., Washington, Sept., 1905, p. 34), but should be written: *Spirillum spirillum* (Müller).

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Spirillum: (Ehrenberg) em. Migula, 1894.

Arb. aus d. Bact. Inst. d. Tech. Hoch. z Karlsruhe, v. 1, h. 2, 1894, p. 236. Cells screwlike, twisted, rigid rods of various thicknesses, length and height of the spiral, forming only a portion of a turn, or a long screw. Endospores in some species. Cells motile by means of a tuft of polar flagella, mostly half circular, rarely wavy-bent.

Type species (subsequent designation by Committee, Am. Bact. Soc., in J. Bact., v. 5, no. 3, May, 1920, p. 204).—*Spirillum undula* (Müller, 1786) Ehrenberg.

Spirillum: Oken, Verm., 1815. According to Scudder, zool. nomen., 1882, p. 298.
Spirillum: Eichw., Polyg., 1844. According to Scudder, zool. nomen., 1882, p. 298.

Spirobacillus: Metchnikoff, 1889.

Ann. l'Inst. Pasteur, v. 3, No. 2, 1889, p. 62, pl. 1.

Type species (monotypy).—*S. cienkowskii.* Pleomorphic. 1. Ovoid cells, more or less elongated, 3 to 5μ, resembling certain species of yeasts (in division the segments are unequal and remain together). 2. Straight rods with rounded ends. 3. Large curved rods. 4. Spirillum forms. 5. Small curved rods. 6. Thin filaments. 7. Spores. Habitat: Parasitic on *Daphnia magna*, coloring the crustacean bright red. Trevisan (Saccardo's Sylloge Fungorum, v. 8, 1889, p. 1019) states that this species is synonymous with *Pacinia cienkowskii.*

Spirochaeta: Ehrenberg, 1834.

Abhandl. d. König. Akad. d. Wissensch. z. Berlin, 1833 (1835), p. 313. See also Die Infusionsthierchen, etc., 1838, p. 83, pl. 5, fig. 10. Spirochaeta: Schlingenthierchen. Family of Zitterthierchen, Vibrionia. Character gen.: Polygastricum (?), anenterum Gymnicum, nec loricatum. Corpus filiforme, contractione non incrassatum, sed flexuosum, sponte in multas partes transverse dividum, spiram angustam, filiformen, plicatilem contortum.

Type species (monotypy).—*Spirochaeta plicatilis.* Vermiform, twisted animals. S. corpore spirali plicatilique, tenuissimo, spirae anfractibus ipso corpore vix duplo lasioribus, angustissimis, numerosissimis. In 1838: Sp. corpore tenuissimo subgloboso, cochleae filiformis longae anfractibus angustissimis numerosissimis, colore hyalino. Divisione spontanea imperfecta in catenam tortuosam s. cochleam filiformen flexibilem elongatum.

Spirochaeta: (Ehrenberg) emend. Hueppe, 1886.

Die Formen der. Bakt., Wiesbaden, 1886, p. 148. Long, spiral, flexible filaments without endospores. Arthrospores or "unknown fructification."

Spirochaeta: Lehmann and Neumann, 1896.

Atlas and Principles of Bacteriology (Trans. by Weaver), Philadelphia, 1901, p. 126. Flexible, long, spiral, coiling threads. Flagella unknown.

Spirochaeta: (Ehrenberg) emended Zuelzer, 1911.

Archiv. f. Protistenk. v., 24, 1911–12, p. 51.

Type species (same type).—*S. plicatilis.* A highly flexible organism, usually living anaerobically. The spirally wound protoplasm is traversed by a straight, elastic, "achsenfaden," and contains regularly divided volutin granules. No morphologically differentiable membrane or periplast present. Circular in cross-section. Zuelzer thinks it belongs between the Schizophytes and Flagellates. She distinguishes it from *Cristispira* by the fact that *Cristispira* is surrounded by an elastic, double-contoured cell-membrane, and possesses unilaterally a plasma-like crista "von einen contractile Randfibrille zogen wird auf." The characteristic difference between *Spirochaeta* and illa is the possession by the latter of a rigid cell membrane and flagella,

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also "zentrale, fadenartige anordnungen stark farbige substanzen erweisen sich stets als zentralkorperartig aus einzelnen Körnchen zusammengesetzt und zergten kein Homologon zum einheitlicher elastischen achsenfadender Spirochaeten." In brief, according to Zuelzer the chief characteristics of *Spirochaeta* are: Spiral structure, "achsenfaden," volutin granules, solubility in trypsin, lacking a morphologically differentiable cell-membrane, and cross-division.

Spirochaeta: (Ehrenberg) em. Winslow, Broadhurst, Buchanan, Krumwiede, Rogers and Smith, 1917.

J. Bact., v. 2, no. 5, 1917, p. 563. Nonparasitic, with flexible, undulating body and with or without flagelliform, tapering ends. Common in sewage and foul water.

Type species (same type).—*S. plicatilis* Ehrenberg.

Spirochaeta (Ehrenberg) em. Buchanan, 1918.

J. Bact., v. 3, no. 6, 1918, p. 313. Slender, spiral cells living free, usually in water containing hydrogen sulfide. Actively motile, flexuous. Flagella unknown. Anaerobic. Protoplasm is spirally wound around a flexible or elastic axis filament. Volutin granules regularly present in the plasma. No differentiation of exterior. Cell circular in cross section.

Type species (same type).—*S. plicatilis* Ehrenberg.

Spirochaeta: Sars, Verm., 1856.
According to Scudder, Nomenclator Zool. Univ. Index, 1882, p. 298.

Spirochaete: Cohn, 1872.

Beit. z. Biol., d. Pflanz., v. 1, Breslau, 1872, p. 224, 1875, p. 204. Variant of *Spirochaeta* Ehrenberg. Cohn (1854) placed *S. plicatilis* under the algal genus Spirulina.

Spirochoeta: Dujardin, 1841.

Hist. Nat. des Infusoires. Dujardin. Paris, 1841, p. 225. Variant of *Spirochaeta* Ehrenberg.

Spirodiscus: Ehrenberg, 1828.

Symb. Physicae. Animalia evertebrata. Decas Prima. Berlin, 1828, p. 34. See also Abhandl. Kaiserl. Akad. z. Berlin (1831, 1832), p. 68, and idem., 1830 (1832), p. 65. Animal e familia Vibrionorum. Div. spontanea imperfecta (et obliqua?) in catenam filiformen s. cochleam rigidam disciformem, accrescens.

Species.—S. fulvus. Sp. cochlea lenticulari, obsolete articulata, fulva, 1/50 mm. partem fere lata.

Spirodiscus: Stein, Mollusca, 1850. Scudder, Zool. Nomenclator. U. Index, 1882, p. 298.

Spiromonas: [1] Perty, 1852.

Zur Kenntniss Kleinster Lebensformen, Bern, 1852, p. 171.

Type species (monotypy).—*S. volubilis.* Syn. (?) (Perty) *Cyclidium distortum* Davaine. Colorless, transparent, 1/500 to 1/110 inch long, a very delicate "Monadine" whose leaf-like body has many fine windings about its long axis. Motile. Rounded ends.

Spiromonas: Engler and Prantl in Die Naturlich. Pflanzenfamilien, Teil 1, Abt. 1*a*, 1896–1900, p. 186, give the species *Spiromonas distortum* Kent, and place it among the Flagellata.

[1] Ellis (in Cent. f. Bakt. Abt. 2, v. 19, 1907, p. 517) connects *Spiromonas cohnii* with his *Spirophyllum ferrugineum* among the thread bacteria.

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Spironema: [1] Vuillemin, June 5, 1905.

Compt. Rend. Acad. d. Sci., Paris, v. 140. 1905. p. 1567. Renames *Spirochaete pallida: Spironema pallidum.* "While submitting to the necessity of creating a new generic name for the animal forms which resemble the Spirochaetes, we think that it is well to keep the same radical in order to recall the similarity which struck Schaudinn. We propose the name of *Spironema* for the Protozoaires spiralés à bouts aigus, qui diffèrent des Trypanosomes par la réduction de l'apparatus nucléaire, de la membrane ondulante et de son prolongement flagelliforme. Le Spirochète pâle deviendra ainsi, dans nomenclature régulière, le *Spironema pallidum.*" [Type.]

Spironema: Klebs, 1893.
Zeit. f wissensch. Zool. 1893, 5. A flagellate.

Spironema. Meek, 1864, Smithsonian Inst. Check List. Invert. Fossil snail.

Spirophyllum: Ellis, 1907.

Proc. Roy. Soc. Edinburg, v. 27, Edinburg, 1907, p. 21. See also v. 28, p. 338, and Centralbl. f. Bakt., Abt. 2, v. 19, 1907, p. 507.

Type species (monotypy).—*S. ferrugineum.* Body of cell elongated, flattened, and spirally twisted. Number of spiral turns may vary from a quarter turn to 15 or more. Width varies from 1 to 6μ. Length may reach 200μ. Middle portion of the cell about 0.25μ thick, edge 0.5μ. No definite membrane, but edge is thickened so as to form a sort of rampart all around the cell. Ends are usually irregular, angular, and unsymmetrical. Spirals close or wide apart. Spiral lengths 3 or 4 times greater than the width. Multiplication by formation of conidia (external constriction), oval, 1μ by 1.75μ. Conidia formed before twisting begins. Ferric hydroxide deposited on its surfaces. Found only in iron water. See *Gallionella*, and *Leptothrix.*

Spirophyllum: Schindler, 1905.

Cited by Buchanan in J. Bact., v. 3, no. 3, Baltimore, 1918, p. 302.

Spiroschaudinnia: Sambon, 1907.

According to Tropical Diseases. Manson. Fourth Ed., New York, 1907, p. 833. Manson places this genus, along with *Treponema* and *Leutocytozoön* under the group *Spiroschaudinnidae* Sambon, 1907, stating: "Unfortunately our knowledge of the Spiroschaudinniae is very imperfect, and their biological position is a matter of controversy. The majority of observers believe them to be bacteria, asserting that they multiply by transverse division, that they possess numerous flagella, and that they are plasmolysed by solutions of NaCl and alkalies. Others contend that they are protozoa, that they multiply by longitudinal division, have no flagella, are not plasmolysed by solutions of NaCl and alkalies, and do not grow on ordinary culture media." Manson considers them to be haemoprotozoa. In the blood of the vertebrate host, the schizonts are minute, wavy or spirally twisted threadlike bodies of uniform length. According to Schaudinn and Prowazek they possess an undulating membrane, but no flagella. Their nuclear apparatus is composed of from 6 to 8 chromatic granules arranged along an axial thread. Schizogony takes place by longitudinal division, but the resulting forms may remain attached end to end for some time, either twisted up together or placed in the same line. Sometimes more than 2 individuals are connected in this way, and their ultimate separation gives the impression of transverse division. The free

[1] dity of this genus see Dobell, Med. Res. Com., Special Report Series, 18. Dobell regards the organism first named by Schaudinn *Spirochaete* to the plant kingdom, and considers that *Spironema* is valid because of

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phase alternates with an endocorpuscular resting phase which occurs within the internal organs of the host, the parasite coiling itself up within the host-cell. In the later stages of infection, relatively long, thick forms have been observed; they may represent sporonts. The parasites have been found in great numbers within the ova of infected ticks. Syn. (Manson): *Spirochaeta* Ehrenberg, pro parte; *Spirochaete* Cohn, pro parte. Also synonymous (Buchanan) with *Treponema* Schaudinn.

Species (included here by Manson).—*S. recurrentis* (Lebert, 1874). Cause of relapsing fever in man. Schizont 7 to 9μ long by 0.25 to 0.3μ broad. *S. duttoni* (Novy and Knapp, 1906); *S. anserina* (Sacharoff, 1891); *S. gallinarum* (Blanchard, 1905); *S. theileri* (Laveran, 1904); *S. ovina* (Blanchard, 1906); *S. jonesi* (Dutton, Todd and Tobey, 1906).

Spirosoma: Migula, 1894.

Reference same as for *Planococcus*, p. 237. Family *Spirillaceae* Migula. Cells, twisted, screwlike, nonmotile, without flagella, rigid. Division in but one direction. Single, free or in small gelatinous colonies.

Type species (monotypy).—*S. lingualis* (Weibel) Migula.

Spirulina: Bory, Polyg., 1824.
Univ. Index to Genera. in Zool., p. 299. In Nomenclator Zool. Scudder, Washington, 1882.

Spirulina: Turpin, 1827.
An alga belonging to the Oscillatoria. See Dict. d'Hist. Nat. de Levrault, v. 50, 1827, p. 309.

Spirulina: Ehrenberg, Polyg., 1839.
According to Scudder in Nomenclator Zool., Washington, 1882, p. 299.

Spirulina: Hueppe, 1885.

Die Formen d.Bakt., Hueppe. Wiesbaden, 1885, p. 148. Rods in the form of straight threads, wavy or screwlike, no endospores. Syn. (Hueppe) *Proteus* Hauser.

Spirulina: Cohn, 1854.

N. Acta. Acad. Leop.-Carol, v. 24, Breslau, 1854, 1, p. 125, plate 15, f. 10–11. Renames Ehrenberg's *Spirochaeta plicatilis: Spirulina plicatilis* (Ehrenberg) Cohn.

Sporonema: Perty, 1852.

Reference as for *Spiromonas*, Perty, pp. 160, 179, and 181.

Type species (monotypy).—*S. gracile:* An exceedingly small, cylindrical, nonsegmented hollow thread, inclosing at one end (rarely at both) one, sometimes even two elliptical little bodies (wohl Sporen). Threads 1/80 inch long, 1/1000 inch broad, very slightly greenish, often found with *Metallacter bacillus*, which it very much resembles, yet always nonsegmented. Motile. Sometimes the spore is broader than the thread. When 2 spores are present "so liegen sie hintereinander oder an den Enden." Hueppe (Prin. Bact. Trans. by Jordan, 1899, p. 29) says it probably belongs to the "swamp bacteria."

Sporonema: Desmatière, 1847. A fungus, belonging to the Hyalosporae.

Sporosarcina: Jensen, 1909.

Centralbl. f.Bakt., Abt. 2, v. 22, 1908–9, p. 340. See also v. 24, 1910, p. 477. Spore-forming cocci of the genus *Sarcina*.

Sporospirillum: Jensen, 1909.

Reference as for *Sporosarcina*. Spirilla forming spores.

Sporothrix: Kligler, 1917.

J. Bact., v. 2, March, 1917, Baltimore, p. 165.

Sporothrix: *S. schenckii*, etc. A fungus genus.

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Staphilococcus: De Grazia, 1903.

La Riforma Med., v. 19, Naples, 1903, p. 710. Variant of *Staphylococcus.*

Staphylococcus: Ogston, 1882.

J. Anat. and Phys., v. 17, 1882–1883, London, p. 27. The grouped form of *Micrococcus.* Found very often with the chain form, yet the two are different and neither form passes over into the other. Thinks the species studied is etiologically connected with infectious osteomyelitis, etc.

Staphylcoccus: (Ogston) emend. Rosenbach, 1884.

Mikroorg. bei den Wundinfectionsk. des Menschen, Rosenbach. Wiesbaden, 1884, pp. 18–21, 5 pls.

Species.—S. pyogenes aureus: A very small coccus; spherical; yellow; pathogenic to man and animals. *S. pyogenes albus.* As above, but white.

Staphylococcus (Ogston, Rosenbach) emended Winslow, Broadhurst, Buchanan, Krumwiede, Rogers and Smith, 1917.[1]

J. Bact., v. 2, Nos. 5 and 6, 1917, pp. 508 and 612. Usually parasitic, cells as a rule in irregular groups or short chains, rarely in true packets, usually Gram-positive. Growth fair to good on the surface of artificial media. Sugars as a rule fermented with acid. Gelatin commonly liquefied. Nitrates may or may not be reduced. Pigment orange or white.

Type species (by inclusion).—*S. aureus* Rosenbach.

Staphylokokkus:

Klebs, Hüppe, and many other German writers, e. g., see Forts. d. Med., 1885, v. 3, p. 203.

Stigmatella: Berkeley and Curtis, 1857.

Berkeley: Introduction to Cryptogamic Botany, London, 1857, p. 313, Fig. 70. No description on this page, only the figure, under which is the legend: "*b. Stigmatella aurantiaca,* Berkeley and Curtis. From specimens on *Sphaeria hibisci,* South Carolina." On p. 314, however, he included both *Chondromyces* and *Stigmatella* under the tribe Isariei. Fr. (spelled Isariacei, Cda, on p. 304) his highest group of the Hyphomycetes. This group is described as follows: Fertile threads, compacted, sometimes replaced by cells. Common receptacle or stem (or stroma) compound. The dry, volatile, spores are found terminating the threads and cells. He later states that in reality *Chondromyces* and *Stigmatella* are "compound mucedines."

Streblotrichia: Guignard, 1890.

Compt. Rend. Soc. Biol., v. 2, ser. 9, Paris, 1890, p. 124.

Type species (monotypy).—*S. bornetii.* Gross appearance: Colorless gelatinous masses, which through desiccation become very hard, and are at times about the size of a pinhead. These zooglœa masses, fixed on the rocks, are composed of a great number of filaments, of indefinite length, rectilinear at their bases, then curved, wound, and bent in all directions, especially at the margins of the gelatinous mass, in which they are embedded. Possess a rather thick membrane. Each filament is made up of cylindrical cells, very uniform and of 1μ in diameter, and not very much longer. Finely granular content. Growth of the filaments is intercalary. No endospores. No arthrospores. Habitat: In the fissures of rocks bathed by the sea.

Streptobacillus: Hlava, 1889.

Sbornik Lekaisky. (Arch. Bohëmes de Méd.) v. Praze, 1889–90, p. 139. A short bacillus in short chains, 0.9μ to 1.2μ by 1.87μ to 2μ. Hlava states that [illegible] the cause of typhus exanthematicus.

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[1] [illegible] hberg, and Parsons in J. Bact., v. 5, No. 3, 1920, p. 161, where the [illegible] *us* may be regarded as the type. "All the other types may be as [illegible] rived from this one."

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Streptobacillus: Pfeiffer, 1889.

According to Flügge: Die Mikroorganismen, v. 2, 1896, p. 452: *S. pseudotuberculosis rodentium.*

Streptobacillus: Unna, 1892.

Monats. f. Prakt. Derm., v. 14, No. 12, p. 485. See also v. 21, No. 2, 1895, p. 61, and Gior. Ital. d Mal. Veneree, Anno 30, Milano, 1895, p. 275.

Species.—*S. ulceris mollis.* Present intracellularly in venereal ulcer. Rods 1.25 to 2μ by 0.3μ broad. Characterized by chain formation. In old chancres wavy chains of 100μ were found. Chains usually of 4 to 10 individuals.

Streptobacillus: Rist and Khoury, 1902.

Ann. l'Inst. Past., v. 16, Paris, 1902, p. 70.

Species.—*S. lebensis.* Straight rods with square ends, not motile, no capsule, 6 to 8μ long by 0.5μ wide. Rather long chains common. Occurring in Egyptian "leben"—a fermented milk.

Streptobacter: Schröter, 1886.

Krypt.-Flora v. Schlesien. Cohn, v. 3, Pilze, Breslau, 1885–1889, p. 156. A subgenus of *Bacillus.* Growth of the cells prior to spore formation into long threads.

Species.—*Bacillus* (*Streptobacter*) *erythrosporos* (Cohn, 1879), *B.* (*S.*) *subtilis*, and three other species.

Streptobacteria: Billroth, 1874.

Reference as for *Coccos* Billroth, pp. 18 and 19, pl. 4, figs. 31–34. Rods in fine, long chains. Individual members may be plainly distinguished. Definite point of union.

Species.—*S. gigas.* Nonmotile rod occurring in chains. *S. pericardii* (p. 61). Syn. (?) *S. gigas pericardii* (p. 60). Developing in pericardial liquid.

Streptobacterium: Billet, 1890.

Reference as for *Diplobacterium* Billet. Rectilinear bacterial elements in chains.

Streptobacterium: Jacqué and Masay, 1912.

Centralbl. f. Bakt., Abt. 1, orig., v. 62, 1912, p. 181.

Type species (monotypy).—*S. foetidum:* A short rod with rounded ends. Very motile, no spores. Chains in bouillon cultures. Gram negative. Pathogenic to man. Found in sputum, plural exudate, etc.

Streptococcos: Billroth, 1874.

Untersuch. u. die Vegetationsformen von Coccobacteria Septica, etc. Berlin, 1874, p. 10, pl. 1. Round or oval cells of irregular dimensions, in chains; division in one direction, the cells remaining united after division to form short chains.

Streptococcus (Billroth) emend. Rosenbach, 1884.

Mikroorganismen bei den Wundinfectionskrank. des Menschen. Wiesbaden, 1884, p. 22. Cocci in chains. "Wollem wir einen Coccus, welcher sich aus mehrere Einzelcoccen zu characteristischen Reihen, Ketten, Eingeln oder rosenkranzähnlichen Figuren gruppirt mit Ogston, welcher Billroth's Nomenklatur acceptirt hat, Streptococcus nennen, so bezeichnet auch hier dieses Wort nur eine Gattung; denn es gibt mehrer Artem, welche sich mikroskopisch in gleicher Weise zu Ketten anordnen."

Species.—*S. erysipelatos*, the organism described by Fehleisen as the cause of erysipelas, and *S. pyogenes* Rosenbach, the pus-producing coccus. Migula (Syst. der Bakt. v. 2, 1899–1900, p. 6) says these two species are synonymous.

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Streptococcus: (Billroth, Rosenbach) emended Winslow and Rogers, 1905.

Science, n. s., v. 21, 1905, p. 669. See also J. Inf. Dis., v. 3, 1906, pp. 485–546, and The Systematic Relationships of the Coccaceae, Winslow and Rogers, New York, 1908. Parasites. Cells normally in short or long chains; under favorable conditions, sometimes in pairs and small groups, never in large packets. Generally stain by Gram. On agar streak, effused translucent growth, often with isolated colonies. In stab culture little surface growth. Sugars fermented with formation of large amount of acid. Generally fail to liquefy gelatin or reduce nitrates.

Type species (subsequent designation by Com. Soc. Am. Bact. in J. Bact., v. 5, no. 3, 1920, p. 206).—*S. pyogenes* Rosenbach.

Streptokokkus: Klebs, Hueppe, 1885–1887, and other German authors.

Klebs (Die Allg. Path., Jena, 1887, p. 318) used it with species names. *S. erysipelatosus, S. pyogenes*, etc.

Streptospirillum: Billet, 1890.

See reference for *Diplobacterium*, p. 24. Spiral forms of "elements bactériens." Spirilla in chains.

Streptothrix: Corda, 1839.

Pracht.-Flora Europaeischer Schimmelp., A. J. Corda, Leipzig and Dresden, 1839, p. 27. *S. fusca.* A fungus closely related to *Botrytis.*

Streptothrix: Cohn, 1875.

Beit. z. Biol. d. Pflanzen, v. 1, Heft 3, Breslau, 1870–1875, p. 186, and 204. Filamenta leptotricholdea tenerrima achroa nonarticulata stricta vel anguste spiralia, parce ramosa.

Type species (monotypy).—*S. foesteri.* Filamenta in Micrococco mucoso nidulentia, concretiones in canaliculo lacrimali hominis raro repertas componentia.

Streptothrix: (Cohn) em. Musgrave and Clegg, 1908.

The Philippine J. of Sci., v. 3, B. Med. Sci., Manila, 1908, p. 476. "A group of branching, filamentous microorganisms which logically belong to a single genus. The generic name is variously given as Streptothrix, Actinomyces, or Nocardia; the last of these names is probably scientifically the most correct, but because of the present botanical confusion and uncertainty the first is here employed, because of its more general acceptance." Branching, filamentous organisms, which develop slowly into colonies made up of the branches and their "transformation products." These colonies vary in color, size, and consistency, and when stained show various changes in different portions. The filaments at the periphery are usually intact, with or without club formation, and the terminals may or may not be radially placed. Toward the center of the colony, or granule, coccus and bacillus-like irregular forms occur, together with crystals and nonstaining detritus. The majority of these organisms may be cultivated on artificial media, some of them pathogenic to laboratory animals.

"Morphologically these parasites are rather closely related to some of the branching bacteria." The young filaments vary in width from 0.5 to 1μ and in length from 5 to 20μ or more. Stain homogeneously, and some strains are acid fast. All strains more or less Gram positive. Causing streptothricosis (Actinomycosis, Nocardiosis) in man and animals. See *Discomyces.*

Strickeria: Stempell, 1916.

Deutsche med. Woch., v. 42, April 13, 1916, p. 439.

species.—S. jurgensi n. g. n. sp. An organism isolated from the intract of the body louse taken from typhus fever patients. Stempell

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thinks it is the cause of typhus fever, and that it probably belongs to the protozoa, somewhere near *Babesia* or *Leishmannia*. Pleomorphic—frequently very small, coccus-like forms are found which may or may not contain a brownish pigment. Comma-like forms, and spindle-shaped in which both ends are delicately pointed—flagella like—not infrequent. With the Giemsa stain there are often seen darker red, nucleus-like bodies centrally located within the cell. The comma-like forms average 2μ in length.

Streptomicrococcos: Billroth, 1874.

Untersuch. u. die Vegetationsformen v. Coccobacteria septica, Berlin, 1874, p. 11. Micrococcos in chains—snakelike, practically nonmotile.

Sulfomonas: Jensen, 1909.

Centralbl. f. Bakt., Abt. 2, v. 22, 1908, 1909, p. 314. Short rods capable of oxidizing sulfur and sulfur compounds. Renames *Thiobacillus* Beijerinck.

Species.—*S. denitrificans* (Beijerinck) Jensen; *S. thioparus* Beijerinck.

Termobacterium: Lindner,[1] (?).

According to Beijerinck (Centralbl. f. Bakt., Abt. 2, v. 4, 1898, p. 211). Zikes (Mitt. d. Öster. Vers.-St. f. Brauind. Wien, 1903, Heft 11, p. 20) gives the species: *Termobacterium album* Lindner. See *Thermobacterium*.

Termobacterium: Zeidler, 1896.

Centralbl. f. Bakt., Abt. 22, v. 2, Jean, 1896, p. 729, 2 figs. Usual form is a rod in pairs end to end. Involution forms frequent. Belongs to the "acetic acid bacteria"; organisms capable of producing acetic acid from certain substances. States that he follows Lindner in naming the organism.

Tetracoccus: Billet, 1890.

See reference for *Diplobacterium*, p. 24. Micrococci in pairs, the pairs in groups of two.

Tetracoccus: Klecki, 1894.

Centralbl. f. Bakt., Abt. 2, v. 15, 1894, pp. 354–362.

Type species (monotypy).—*T. butyri*. Diplococci united in twos, or in chains and heaps. The pairs of cocci measure about 15μ long and 1μ thick. Habitat: Rancid butter.

Tetrakokkus: Klebs, 1887.

Die Allg. Path. Edwin Klebs. Jena, 1887, p. 337.

T. variolae. The cause of variola. Very characteristic arrangement. Diameter usually about 0.6μ.

Tetradiplococcus: Bartoszewicz and Schwarzwasser, 1908.

Centralbl. f. Bakt., Abt. 2, v. 21, 1908–9, p. 614. A Diplococcus, showing tetrad grouping. The diplococci resemble gonococci in their biscuit-like form. The tetrads (4 to 6μ in diam.) are either in squares or rhombi, and usually 2, 3, or more are confined. The tetrads show motility, but no flagella were stained.

Type species (monotypy).—*T. filiformis lodzensis*. Found in "lodzer Brunnenwasser."

Tetragenus: Kruse, 1896.

Die Mikroorganismen. Flügge, v. 2, Leipzig, 1896, p. 94. A coccus showing typically arrangement into tetrads. Placed it as a group under *Merista*.

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[1] Lindner's paper is not available.

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Tetragenus: Vincenzi, 1897.

La Riforma med., 1897, p. 758. According to Centralbl. f. Bakt., Abt. 1, v. 24, Jena, 1898, p. 193.

Species.—T. citreus. A facultative anaerobe isolated from the intermaxillary lymph gland of a child.

Tetragenus: Altana, 1909.

Centralbl. f. Bakt., Abt. 1, v. 48, Jena, 1909, p. 44.

Species.—T. tardissimus. A nonmotile oval coccus arranged in tetrads surrounded usually by a capsule. Gram positive. Isolated from the blood in a contagious disease of guinea pigs.

Thermoactinomyces: Tsiklinksy, 1898.

Ann. de Microg. v. 10, Paris, 1898, p. 286. See also Ann. de l'Inst. Past., v. 13, Paris, 1899, p. 500.

Type species (monotypy).—*T. vulgaris.* Branched filaments, the branches about 0.5μ long. Spores appear at the end of the filaments as round as ovoid swellings, increasing in size, becoming free finally. Grows from 48° to 68° C. Best at 57° C. Found it in various substances: Earth, hay, straw, different cereals, etc.

Thermobacillus: Jensen, 1909.

Centralbl. f. Bakt., Abt. 2, v. 22, 1908–9, p. 339. Thermophilic, spore-forming, peritrichiate, aerobic bacilli.

Thermobacterium: Fuhrmann, 1905.

Variant of *Termobacterium* Lindner. Beihefte z. Bot. Cent., 2, v. 19, Leipzig, 1905, p. 8. See also Centralbl. f. Bakt., Abt. 2, 1897, p. 770 (index): *T. aceti.*

Thiobacillus: Beijerinck, 1904.

Centralbl. f. Bakt., Abt. 2, v. 11, 1904, p. 593.

T. thioparus.—Small, thin, short rods, 3 to 3.5μ. Very motile. No spores. Organism occurs in fresh water and is capable of using carbonates as a source of C, with H_2S, $Na_2S_4O_6$, etc., as sources of energy.

Thiobacillus denitrificans.—Similar morphologically to *T. thioparus,* but effects the reduction of carbonates through free S as a source of energy with denitrification.

Thiocapsa: Winogradsky, 1888.

Beitr. z. Morph. u. Physiol. d. Bacterien. Leipzig, 1888, Heft 1, p. 84. Cells round, nonswarming, united into families by means of a gelatinous membrane, which splits upon growth of the family. Cells divide in 3 directions. Belong to the "red sulfur bacteria." Usually rose-red in color. Rich in S granules.

Type species (monotypy).—*T. roseo-persicina* nov. gen. et spec. Cells are 1.1 to 2μ in diameter.

Thiococcus: Jensen, 1909.

Centralbl. f. Bakt., Abt. 2, v. 22, 1909, p. 330. Belonging to the family *Thiobacteriaceae,* colorless sulfur bacteria. Nonfilamentous cocci.

Thiocystis: Winogradsky, 1888.

Beit. z. Morph. u. Phys. d. Bact. v. Winogradsky. Heft 1, Leipzig, 1888, p. 60. Cells spherical and united into small families surrounded by a gelatinous cyst. Sometimes a single individual is surrounded by such

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a cyst. Capable of swarming. Measure 1 to 5μ in diameter. Cells divide in 3 directions. Cell-content granular. Bacteriopurpurin present. Red sulfur bacteria.

Type species (subsequent designation by Buchanan in J. Bact., v. 3, No. 5, Balto., 1918, p. 466).—*T. violacea* Winogradsky. 2.7 to 5.2μ. Bright red or red violet in color.

Thioderma: Miyoshi, 1897.

J. College of Sci., Imp. Univ. of Tokyo, 1897, p. 143, fig. 19.

Type species (subsequent designation by Buchanan in J. Bact., v. 3, no. 5, Balto., 1918, p. 468).—*T. roseum* Miyoshi. Spheroidal cells, 2.5 by 1.5μ, colored bright red with small S granules. Cells united by means of thin purple-red membrane; capable of swarming. Habitat: moist soil.

Thiodictyon: Winogradsky, 1888.

Reference as for Thiocystis, p. 80. Rod-shaped cells, with ends united to form a net. Compact families may spread out to form a Hydrodictyon-like arrangement. Cells divide in but 1 direction. Families multiply by division or rarely by separation of slowly motile small cell colonies (5 to 15 cells). Bacteriopurpurin and S granules present.

Type species (monotypy).—*T. elegans.* Slender, spindle-shaped rods with pointed ends, 5μ long by 1.7μ thick. Vacuole present. Small S granules. Rods almost colorless.

Thiomonas: Jensen, 1909.

Centralbl. f. Bakt., Abt. 2, v. 22, 1909, p. 330. Belonging to the *Thiobacteriaceae,* colorless sulfur bacteria. Nonfilamentous rods.

Thiopedia: Winogradsky, 1888.

Reference as for *Thiocystis,* p. 85. Cells spherical. Division in two directions of space. Cells united into families which are tabular, i. e., the cells are arranged in fours united by a gelatinous substance. Capable of swarming. Contains S granules and bacteriopurpurin.

Type species (monotypy).—*T. rosea.* Syn. (Winog.) (?) with *Erythrococnis littoralis* Oersted, and *Merismopedia littoralis* Rabenhorst described by Warming. Cells 1.1 to 2μ in diam. Very pale color; when in thick layers slightly rose-red.

Thiophysa: Hinze, 1903.

Ber. d. deut. Bot. Gesellsch., Heft 1, v. 21, 1903, p. 309. Spherical cells, laden with sulfur drops, surrounded by a membrane giving pectin reaction. Large vacuole centrally located. No nucleus. No flagella. Multiplication by fission, the daughter cells at first biscuit-shaped.

Type species (monotypy).—*T. volutans* n. sp. Diameter 7 to 18μ. Slow, circular motion. Habitat: Gulf of Naples, near Castellamare in fine sand.

Thioploca: Lauterborn, 1907.

Ber. d. deutsch. Bot. Gesellsch., v. 25, 1907, p. 242. Family *Beggiatoaceae.* Threads Beggiatoa-like, with true sulfur granules; motile; cells often arranged in parallel manner in bundles, etc. A colorless gelatinous sheath is present, usually encrusted with slime particles, and showing circular constrictions.

Type species (monotypy).—*T. schmidlei.* Cells 5 to 9μ thick, and 1 to 1,5 times as long. Habitat; sea beds, near Ermatingen.

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Thiopolycoccus: Winogradsky, 1888.

Reference as for *Thiocystis*, p. 79. Cells spherical or elliptical, closely pressed together to form solid families, which are nonmotile. The cells divide in 1 direction and are about 1.2μ in diameter. Multiplication of the colonies by a loosening up of the surface which gradually breaks up into short threads and folds, which continue to form still smaller heaps. No zoogloeae as in *Lamprocystis*.

Type species (monotypy).—*T. ruber*. Swarming not observed. Brightly colored, small, round cells.

Thiosarcina: Winogradsky, 1888.

Reference as for *Thiopolycoccus*, p. 105. Red sulfur bacteria. Cells divide in 3 directions, and are united into families, which are packet-shaped. Do not swarm. Bacteriopurpurin present.

Type species (monotypy).—*Thiosarcina rosea* (Schröter) Winogradsky.

Thiosphaera: Miyoshi, 1897.

Reference as for *Thioderma*. Cells sphaero-ellipsoidal, 5 to 7μ; light violet color; united into families by a colorless gelatinous substance. Sulfur granules rather numerous. Capable of swarming.

Type species (monotypy).—*T. gelatinosa*.

Thiosphaerion: Miyoshi, 1897.

Reference as for *Thioderma*. Cells sphaero-ellipsoidal, about 1.8 to 2.5μ diameter. Violet in color. Very small S granules. Cells bound by a gelatinous substance into solid round families capable of swarming.

Type species (monotypy).—*T. violaceum* Miyoshi.

Thiosphaerella: Nadson, 1914.

J. Microbiologie (Russian), v. 1, No. 1–2, Petrograd, 1914, pp. 52 and 70.

Type species (monotypy).—*T. amylifera*. A sulfur bacterium. Cells are round or slightly elliptical, measuring 4.8 by 6μ. A very thick cell membrane enveloped in a colorless gelatinous layer. Protoplasm sometimes has a gray-green color, and in it are found sulfur granules, and a substance resembling starch. Motile. Multiplication by transverse division. Found frequently associated with *Thiophysa* Hinze and *Achromatium* Schewiakoff.

Thiospira: Wislouch, 1914.

J. de Microbiologie (Russian), v. 1, No. 1–2, Petrograd, 1914, p. 50. Motile, colorless, slightly curved sulfur spirilla with pointed ends. Sulfur granules present. A few polar flagella. *T. winogradskii* (Omélianski). A giant sulfur spirillum 3.5μ by 50μ. *T. bipunctata* (Molisch). Small, very delicately curved sulfur spirilla 1.7 to 2.4μ by 6.6 to 14μ long.

Thiospirillum: Winogradsky, 1888.

Reference as for *Thiocystis*, p. 104. Cells free, capable of swarming at any time, and spirally twisted like the genus *Spirillum;* cells contain sulfur granules.

Type species (monotypy).—*T. sanguineum* (Ehrenberg) Winogradsky.

Thiothece: Winogradsky, 1888.

Beit. z. Morph. u. Phys. d. Bact. v. Winogradsky. Heft 1, Leipzig, 1888, p. 82. Cells united into families by means of a thick gelatinous membrane. Cells capable of swarming and loosely embedded in a gelatinous substance. The cells are coccus-like, about 4μ in diameter, and divide in but one direction. Upon swarming the cells lie still more loosely and swarm out

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singly. The sulfur granules are small; the cells are gray-violet or weak rose in color, sometimes yellowish. Bacteriopurpurin present.

Type species (monotypy).—*T. gelatinosa.*

Thiothrix: Winogradsky, 1888.

Reference as for *Thiocystis*, p. 29. Filamentous cells; threads attached; of irregular thickness and enveloped in a delicate membrane. Nonmotile. Cell contents have many sulfur granules. Reproduction through rod-shaped conidia which are slowly motile. These conidia are produced at the ends of the threads. They attach themselves by means of a slime cushion extruded at the base, then grow into new threads.

Type species (subsequent designation by Buchanan in J. Bact., v. 3, No. 5, Baltimore, 1918, p. 463).—*T. tenuis.*

Thiotrix: Schmidt and Weis, 1902.

Die Bakt., Jena, 1902, p. 92. Variant of *Thiothrix* Winogradsky.

Torula: Persoon, 1801.

Defined as a fungus. Changed to *Oospora* by Wallroth 1833. Trevisan (Saccardo's Syll. Fung., v. 8, 1889, p. 1021) says *Torula aceti* Sacc. (Atti. Soc. Ven. Trent. v. 1878, p. 315) is synonymous with *Bacterium aceti.*

Treponema: [1] Schaudinn, October 26, 1905.

Deut. med. Wochnschr., No. 43, v. 31, pt. 2, 1905, p. 1728. See also No. 42, p. 1665. In the earlier reference Schaudinn discusses the morphology of his *Spirochaete pallida*, and accepts Vuillemin's designation: *Spironema.* However, on p. 1728 he says: "Nach Absendung des Manuskripts meines in no. 42 veröffentlichten Aufsatzes 'Zur Kenntnis der Spirochaete pallida' teilte mir Herr Prof. Lauterborn mit, dass der von Vuillemin vorgeschlagene Gattungsname *Spironema* bereits von Klebs (Zeits. f. wissensch. Zool., 1893, v. 55) für einen anderen Flagellaten vergeben sei. Ich schlage deshalb statt dessen den Namen *Treponema* vor."

Type species (monotypy).—*Treponema pallidum.*

Treponema: (Schaudinn) em. Winslow, Broadhurst, Buchanan, Krumwiede, Rogers, and Smith, 1917.

J. Bact., v. 2, no. 5, Sept., 1917, p. 563. Parasitic and frequently pathogenic forms with undulating or rigid spirilliform body. Without crista or columella. With or without flagelliform tapering ends.

Type species (original designation).—*Treponema pallidum* Schaudinn.

Tyrothrix: Ducleaux, 1882.

Ann.l'Inst. Nat. Agronomique, Sêr. 1, No. 5, 4e An., 1879–80, Paris, 1882, p. 79. See also Le Lait. Ducleaux, Paris, 1887, pp. 213–215. Organisms which live in milk, feeding upon the casein with production of casone, leucine, tyrosine, and other protein cleavage products. Author includes: *T. tenuis.* Short, cylindric rods, motile, often remaining united to form chains. Content granular, 0.6μ by 3μ. Aerobic. *T. filiformis, T. distortus*, and 8 others.

Ulvina: Kützing, 1833–1837.[2]

Algarum aquae dulcis germinae, Dec. XII, No. 113. According to J. f. Prakt. Chem. (Erdmann), Bd. 11. 1837, p. 385, and Phycol. Gen. Leipzig, 1843, p. 149. Stratum compactum lubricum ex granulis minutissimis compositum.

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[1] See footnote under *Spironema.*

[2] The whole series. Decas 1 to 16. of this reference was published 1833–1837. It is impossible to obtain this particular number and ascertain exact date.

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Type species (monotypy).—*U. aceti.* Primum membranacea, deinde stratum compactum, in ramos dichotomos dense aggregatos verti caliter divisam formans; granulis aequalibus. Trevisan (Sacc. Sylloge Fungorum, v. 8, 1889, p. 1021) says *U. aceti* is syn. with *Bacterium aceti.* In the second reference given above Kützing describes this species, or "essigmutter," as follows: Exceedingly small spheres, 1/2000 to 1/1500 inch diameter, sometimes arranged in series, but usually in a gelatinous mass. From this stage it passes through several changes, a dichotomously branching stage, and a final stage, in which longish bodies appear.

Umbina: Nägeli, 1848.

Gattungen einz. Algen Phys. u. Syst. bearb., Zürich, 1848. See also Amtlich. Ber. u. die drei u. dreisigste versamml. Deut. Natur. u. Ärzte zu Bonn, 1857, p. 133. Gives but a brief description, stating that it is the "mother of vinegar," and very similar to *Nosema bombycis*, except that the cells remain united.

Type species (monotypy).—*U. aceti* (Kützing) Nägeli.

Urobacillus: Miquel, 1889.

Ann. d. Micrographia, v. 1, 1888–89, p. 519. All bacilli which ferment urine.

Type species (monotypy).—*U. pasteurii.* Short motile bacillus about 1μ in length. Later (p. 552) he adds several other species.

Urobacter: Trécul, 1865.

According to Cohn: Beitr. z. Biol. d. Pflanz. 1, 1870–1875, Breslau, p. 188. Cohn states that Trécul placed in this genus "geschwänzten bacterien."

Urococcus: Miquel, 1888.

Reference as for *Urobacillus*, p. 519. Cocci which ferment urine.

Urococcus: Hassall, 1845. Defined it as an alga (fresh water).

Urocephalum: Trécul, 1865.

Compt. rend. de l'Acad. des Sci., v. 61, Paris, 1865, p. 432, and v. 65, 1867, p. 513. The tadpolelike form of *Amylobacter.* Motile, somewhat flexuous; cell stained intense blue with iodine. Found in decaying plant cells.

Urosarcina: Miquel, 1889.

Ann. de Micrographie, v. 1, 1888–1889, p. 519. Species of *Sarcina* which ferment urine.

Vibrio: Müller, 1773.

Vermium terrestrium et fluviatilium, 1773, p. 39. See also Animalcula Infusoria Fluviatilia et Marina, Havniae, 1786, p. 43. Placed the genus in the group of Infusors: *Infusoria crassiuscula*—vermis inconspicuus simplicissimus, teres, elongatus.

Type species (first in order of arrangement).—*V. lineola.*—Linearis minutissimus. Animalculum omnium minutissimum; monadem termonem exiguitate, fere superans, Vibrioneque Bacillo tricies minus et prorsus diversum. *Motus* tremulus myriadum punctulorum oblongorum obscuriorumque in unica guttula, seu undulatio oculo, lenticula maxime amplificante, exhibetur. In infusione vegetabili sbstantiam aquae post plures dies fere adimpler; in alia foetente ultra trimestre servata, et in non foetente post menesem Lemna cooperta cum Cyclidio glaucomate. He included also *V. bacillus*, *V. undula*, and later a number of other species: *V. scrpens*, *V. spirillum*, *V. rugula*, etc., some are regarded as belonging to the bacteria.

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Vibrio: (Müller) em. Ehrenberg, 1832.

Abhandl. d. K. Akad. Wiss. Berlin, 1830 (1832), p. 38. Ehrenberg excluded from the genus *Vibrio* the "sinuous" forms which he placed in the genus *Spirillum*, including under the genus *Vibrio*, the straight, flexible rods.

Vibrio: (Müller) emend. Cohn, 1872.

Beit. f. Biol. d. Pflanz., Cohn. Heft. 2, Breslau, 1872, p. 178. Wavy, bent threads.

V. rugula Müller: Threads thick with a single curve. *V. serpens* Müller: Thin threads, with several wavelike curves.

Vibrio: (Müller) emend. Zopf, 1885.

Die Spaltpilze. W. Zopf, Breslau, 1885, p. 50. Spiral filaments with spores.

Vibrio: (Müller 1786) emended Buchanan, 1918.[1]

J. Bact., v. 3, no. 6, 1918, p. 178. Short bent rods, sometimes almost straight, motile by means of a single (rarely two or three) polar flagellum. Aerobic and facultative. Grow well on ordinary media. Frequently liquefy gelatin. Not enlarged near center. No spores. Usually Gram negative.

Type species (original designation).—*V. cholerae.*

Vibriocephalus: Mantegazza, 1851.

Giorn. d. R. Ist. Lomb., c. 3, Milano, 1851, p. 486. Placed it, along with *Spirillum, Bacterium*, etc., among the Infusoria. Asymmetrical infusoria. No visible organs of locomotion. Belong to the family: Vibrionii: Filiform animals, very thin. *Vibriocephalus:* Filiform body, not articulated, with a truncated extremity, the other provided with an oval head. Vacillating motion.

Type species (monotypy).—*V. pignacea*, Diaphanous, cylindrical little animal, with a length of four or five times its breadth, with an oval head one-third length of the body; general form very similar to the human zoosperm.

Vibrion: Pasteur, 1876.[2]

Vibrion septique is a vernacular name used first by Pasteur, but not with generic distinction, and later by many early investigators. It occurs frequently in modern literature, e. g., Lancet v. 2, April, 1919, p. 657. Considered by many authors as synonymous with *Bacillus oedematis.* (See *Clostridium* and *Granulobacillus.*)

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[1] Buchanan points out that if the generic name of *Vibrio* should be suppressed because of the varied meanings assigned to it in the past, *Paccinia* Trevisan would definitely have priority.

[2] It seems very probable that Pasteur never obtained pure cultures of this organism (see Compt. Rend. de l'Acad. des Sci., T. 85, Paris, 1877, p. 101, and Bull. de l'Acad. de Méd., sér. 2, v. 6, p. 781). He points out its morphological differences from the anthrax organism, which he says it resembles very closely in this way, and also in the lesions it produces. Pasteur discovered it by inoculating rabbits and guinea pigs with bits of putrid flesh which produced local oedema and degenerative changes in various organs, a condition which Pasteur termed "septicémie gangreneuse." Miquel and Cambier (Traité de Bact., Paris, 1902, p. 389) state that the *Vibrion septique* is *Bacillus septicus* of French writers.

The Medical Research Committee (National Health Insurance) in their "Reports of the Committee upon Anaerobic Bacteria and Infections," London, 1919, Special Report Series, No. 39, have the following to say regarding the *vibrion septique:* "This microbe has been the center of much controversy; it has, however, become clear that an organism agreeing in characters with Pasteur's *vibrion septique* is of frequent occurrence in wounds. Numerous strains have been isolated and the characters of the bacillus are now perfectly well known. *Vibrion septique* and *B. oedematis maligni* of Koch are probably identical. Many writers subsequent to Koch, such as von Hibler, C. O. Jensen, von Werdt, and others, have, however, repeatedly described *B. oedematis maligni* as liquefying serum

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Viscomyces: Rivolta and Micellone, 1879.

According to Buchanan, J. Bact. v. 3, no. 4, July, 1918, p. 198, Misprint(?) of *Discomyces*, Rivolta, 1878.

Winogradskya: Trevisan, 1889.

Gen. e Spec. delle Batteriacee, 1889, p. 12. According to De Toni & Trevisan, Sacc. Syllog. Fung., v. 8, 1889, p. 1028. Baculi cylindracei et filamenta aggregata in familias zoogloeicas repetite ramosas, capsula tenui gelatinosa inclusa. Sporae ignotae.

Type species (monotypy).—*W. ramigera* (Itzingsohn).

Zoogalactina: Schröter, De Toni and Trevisan, and others.

Variant of *Zoagalactina*. Schröter: Krypt.-Flora v. Schlesien, F. Cohn, v. 3, pt. 1, 1885–1889, Pilze, p. 143.

Zoagalactina: Sette, 1820? (1824).

Memoria storico-naturale sull'arrossimento straordinario di alcune sostanze alimentose, osservato nella provincia di Padova l'anno 1819 letta all 'Ateneo di Treviso, ser. 28, April, 1820. Venezia, 1824, p. 51.

Type species (monotypy).—*Z. imetropha.* Cause of "cholera morbus." According to Trevisan: Rend. Reale Ist. Lomb., Ser. 2, 1879, p. 141, who says it is syn. with *Micrococcus imetrophus* Trevisan. Vuillemin (Ann. Mycologici, v. 11, 1913, p. 523) says it is syn. with *Serratia.*

Zoogloea: Cohn, 1853.

Novorum Actorum Acad. Caesareae Leopold.-Carolin. Nat. Curiosorum, v. 24, Breslau and Bonn, 1854, p. 123. Cellulae minimae, bacilliformes, hyalinae, gelatina hyalina in massa mucosas globosas, uvaeformes, mox membranaceas consociate, dein singulae elapsae, per aquam vacillantes.

Type species (monotypy).—*Z. termo.* Cellulis liberis mobilibus, rectis, 1/2000 to 1/700 inch aequantibus. Syn. (Cohn). *Palmella infusionum* Ehrenberg. *Micraloa teres* von Flotow, *Bacterium termo* Dujardin, *Vibrio lineola* Ehrenberg.

NOTE.—Cohn later abandoned this as a generic name, retaining the term as descriptive of one of the stages in the evolution of bacteria of certain species.

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and digesting meat with the production of a putrid odor. These reactions do not obtain in pure cultures of undoubted *vibrion septique*, the inference being that these writers and even certain quite recent workers, such as Conradi and Bieling, were dealing with impure cultures.

"Confusion has also arisen in the tendency to consider *vibrion septique* as identical with *B. chauvoei* (bacillus of Rauschbrand). This is undoubtedly an error. *B. chauvoei* is quite distinct from *vibrion septique*, but strains of *vibrion septique* have been isolated from cases which appeared clinically to be symptomatic anthrax and also from accidental wounds in animals.

"*Morphology* [of *vibrion septique*]: A Gram-positive organism; it is motile in young cultures and in the exudate from infected animals. It presents a rather wide range of different forms according to the conditions of the culture. In broth or in meat medium the organisms appear as rods of varying length somewhat more slender than *B. welchii.* Spores are readily formed and are usually situated toward one extremity; central spores are, however, not uncommon. Deeply stained bulblike types may be present, especially in young cultures. In fluid media containing fresh tissue and on coagulated serum very varied appearances may be seen, such as 'navicular,' or 'citron' types, i. e., pale, citron or boat shaped bodies with deeper staining points at one or both extremities, deeply staining club-shaped forms, filaments, and bulblike types often growing in short chains. The navicular forms may be observed in films made directly from infected tissues and blister fluid, etc. * * * A strict anaerobe; rancid odor, but not putrid, when grown in meat medium, with color varying from bright red to pink—no blackening; acid and clot in milk with some gas (3 to 6 days); no liquefaction of coagulated serum; gelatin liquefied; no fermentation of glycerine, saccharose, inulin, mannit or dulcit, while glucose, laevulose, galactose, maltose, lactose, and salicin are fermented. Pathogenic to pigeons, guinea pigs, mice, rabbits, and dogs.

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Zopfiella: Trevisan, 1885.

Atti d. Accad. fisio-medico-statis. in Milano, ser. 4, v. 3, 1885, p. 93. Three stages of vegetative development: 1. Filaments. 2. Bacilli. 3. Cocci. Filaments are the typical protoplasmic stage; cylindric, articulate, colorless, of two types: macrobacilli and microbacilli. The cocci (final stage) are derived from the microbacilli, and are at first in short chains, finally free. Spores.

Type species (monotypy).—*Z. tumescens.* Syn. *B. tumescens.*

Zopfius:[1] Wenner and Rettger, 1919.

J. Bact. v. 4, No. 4, Baltimore, July, 1919, pp. 334 and 350. Cells rod-shaped, usually about 0.8 by 3.5μ in size, have somewhat rounded ends, and in young cultures occur in long evenly curved chains. Gram-positive. Motile by means of peritrichiate flagella. No spores. No capsules. Facultative anaerobes. No visible change in litmus milk. Gelatin not liquefied and none of the carbohydrates are attacked. A more or less characteristic spider-web growth on agar and gelatin plates, but inoculations in the condensation water of agar slants do not result in a spreading over the surface such as occurs in the genus *Proteus.* The authors include here *Bacterium zopfii* Kurth, and *Proteus zenkeri* Hauser, which they regard as identical, after a study of a number of strains of each type finding few differentiating properties. See *Proteus* (Hauser) em. Wenner and Rettger. The name *Zopfius* having been chosen as the name for this new genus, the type species (by virtual tautonomy) would be *Zopfius zopfii* (Kurth) Wenner and Rettger. See *Kurthia.*

Zymosotia: Salisbury, 1868.[2]

Microscopic examination of the blood; and vegetations found in variola, vaccinia, and typhoid fever. J. H. Salisbury, New York, 1868, 65 pp.

Z. regularis.—Spores very minute, well defined in outline, and uniform in size and shape. Multiply by duplicative segmentation, and develop into filaments with great rapidity. Filaments are well defined, uniform in diameter, and have cross markings or interruptions in the inside tubular membrane at regular intervals, hence its name. Found in human blood.

Z. escularis.—The filaments in their early stages of development are mostly moniliform. The more mature filaments have the outside tube continuous and uniform in diameter, while the inside membrane has not only interruptions at irregular intervals, but the interruptions are of variable length. Where the inside membrane occurs it affords a double wall to the tube and communicates greater opacity than have the intervening spaces. Found in the freshly drawn blood of horses affected by a fatal disease characterized by a remittent fever.

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[1] This new genus is introduced by Wenner and Rettger to include the two species above mentioned which have formerly been placed under *Proteus, Bacterium* or *Bacillus.* They separate them from *Proteus* as defined by them, because of their inability to attack carbohydrates, their nonliquefaction of gelatin, their retaining of the dye when stained by Gram's method, etc.

[2] Salisbury undoubtedly was working with mixed growths. He speaks of these species as "algoid vegetations." Most authors have omitted them from either the Hyphomycetes or the Schizomycetes. Marchand (Bot. Crytogamique, t. 1, Paris, 1883, p. 470) seems to think that this genus, together with three others created by Salisbury (*Crypta, Byolysis,* and *Ios*), belong near or with the schizomycetes. He considers that *Entophycus* Salisbury belongs to the Mucedinaceae.

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Zygobacterium: Maggi, 1887.

Acque Potabili, 1887, p. 318, fig. 184. According to De Toni and Trevisan in Saccardo's Sylloge Fungorum, v. 8, 1889, p. 1023.

Type species (monotypy).—*Z. nitrosum*. Syn. (De Toni and Trevisan) *Bact. lineola* (Müller, Cohn).

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LIST OF SPECIES.

aceti, Kützing, 1833–1837 (Hansen). Ulvina. Type. See also Acetimonas, Arthrobacterium, Nosema, Acetobacter, Bacillopsis, Umbina, Mycoderma, Torula.

aceti, Furhmann, 1905. Thermobacterium.

actinomyces, Trevisan, 1889. Nocardia.

aerogenes, Miller, 1886. Helicobacterium.

aerogenes capsulatus,[1] Welch & Nuttall, 1892 [Bacillus]. See Granulobacillus and Clostridium.

aeruginosa (Kützing, Microhaloa) Henfrey, 1856. Clathrocystis. Type.

agile, Jensen, 1909. Denitrobacterium.

agilis, Beijerinck (?) 1901. Azotobacter.

agilis (Cohen) Migula, 1894. Planosarcina.

agilis, Ali Cohen, 1889. (Micrococcus) Winslow and Rogers. Rhodococcus.

aggregatum, Lauterborn, 1906. Chlorochromatium. Type.

aggregatum, Lauterborn. Chlorochromatium, Cylindrogloea.

alba, Vaucher (Oscillaria), Trevisan. Beggiatoa. Type.

albae, Forti, 1901. Oenobacillus. Type.

albida, Trevisan, 1889. Cenomesia.

album, Lindner, 1887 (?). Termobacterium.

albus, Lindner, 1887. Pediococcus.

alvei, Cheshire and Cheyne, 1888. Cornilia.

americanus, Buchanan, 1918. Nitrosococcus. Type.

amylifera, Nadson, 1914. Thiosphaerella. Type.

amylobacter, Van Tieghem, 1877. Granulobacter.

amylophilum, Makrinov, 1916. Pectinobacter. Type.

amylovora, Burrill, 1883 (Bacillus). Erwinia.

anceps, Trevisan, 1889. Rasmussenia.

anserina, Sacharoff, 1891. Spiroschaudinnia.

anthracis, Davaine (Cohn, Koch). Aplanobacter. Type. See also Bacillus.

apiculatum, Troili-Peterson, 1903. Brachybacterium.

aquatilis, Nissen, 1889. Coccus.

arachnoidea (Agardh), Rabenhorst, Eubeggiatoa.

arborescens, Trevisan, 1889. Nocardia.

articulata (Ehrenberg), Trevisan, 1879. Mantegazzaea.

articulatum, Ehrenberg, 1838. Mantegazzaea.

ascoformans, Johne, 1885 (Micrococcus). Botryococcus, Botryomyces, Bollingera.

asterospora, Meyer, 1897. Astasia. Type.

atoma, Bory de St. Vincent, 1824. Melanella.

aureus, Rosenbach, 1884. (*Staphlyococcus pyogenes aureus* Rosenbach.) Aurococeus. Type. See also Staphylococcus. Type.

aurantiaca, Berkeley and Curtis, 1857. Stigmatella.

aurantiacus (Schröter, 1886), Cohn. Micrococcus.

aureus, Thaxter, 1892. Myxobacter.

avicidus, Gamaleia, 1888. Coccobacillus. Type. See also Pasteurella.

bacillosus, Winogradsky, 1888. Amoebobacter.

bacillus, Müller, 1773. Vibrio. See also Bactrella, Enchelys, and Metallacter.

bacillus (Müller, 1773), Perty, 1852. Metallacter. Type.

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[1] Com. Soc. Am. Bact. (J. Bact., v. 5, No. 3, 1920, p. 222) place this species under Clostridium (Trécul) Prazmowski.

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bactifera, Perfiliev, 1914. Cylindrogloea.
beigelianum, Hallier, 1868 (Sclerotium). Chlamydatomus.
beigelii Küchenmeister and Rabenhorst, 1867. Pleurococcus. See also Chlamydatomus, and Hyalococcus.
beijerinckii, Jensen, 1909. Rhizomonas.
betae, Gonnerman, 1907. Myxobazillus.
betae, Gonnerman, 1907. Myxokokkus.
bicolor, Ehrenberg, Eumonas.
biflexa, Wolbach and Binger (?), Leptospira.
billrothii, Cohn, 1875. Ascococcus Cohn. Type. See also Ascobacillus.
bipunctata (Molisch), Wislouch, 1914. Thiospira.
bornetii, Guignard, 1890. Streblotrichia. Type.
bombycis, Nägeli, 1857. Nosema. Type. See also Panhistophyton.
botryogenes, Rabe (Micrococcus), 1886. Botryococcus, Botryomyces, Bollingera.
botulinus,[1] van Ermengem (Bacillus), 1917. Botulobacillus.
bovis, Babès, 1889. Haematococcus.
bovis, Czaplewski, 1900. Corynethrix.
bovis, Harz, 1877. Actinomyces. See also Oospora.
braunii, Kützing, 1849. Botryococcus. [Alga.]
brevis endocarditidus, Weichselbaum, 1887. Diplobacillus.
buccalis, Robin and Lebert. Leptotrichia.
buccalis, Robin and Lebert (Trevisan, 1889). Rasmussenia.
buccalis, Robin, 1847. Leptothrix. Type.
buccalis, Lewis, 1884. Microspira.
bulbali, Trevisan, 1887. Pasteurella.
butylicus (Grüber), Migula, 1900. Granulobacter.
butylicum, Beijerinck, 1893. Granulobacter.
butyri, Klecki, 1894. Tetracoccus. Type.
butyricum, Prazmowski, 1880. Clostridium. Type.
callitrichae, Kützing, 1837 (an alga). Sclerothrix.
capsulatum, Molisch, 1907. Rhodonostoc. Type.
capsulatum, Molisch, 1907. Rhodobacterium. Type.
capsulatus, Foà and Bordoni-Uffreduzzi, 1888 (Diplococcus). Meningococcus.
capsulatus, Molisch, 1907. Rhodococcus.
capsulatus cuniculi, Koppanyi, 1907. Pyobacillus. Type.
capsulatus pyaemiae cuniculi, Koppanyi, 1907. Pyobacillus.
candicans, *Flügge*, 1886. Albococcus.
canescens, Migula, 1899–1900. Albococcus.
casei, Freudenreich (Bacillus). Caseobacterium.
catenata, van Tieghem, 1880. Polybacteria.
caucasica, Kern, 1882. Dispora. Type.
caucasicus (Kern) Beijerinck. Lactobacillus.
cellaris, Schröter, 1883. Leucocystis, Chlamydatomus.
cellaris, Hansgirg, 1888. Mycothece.
centrale, Oersted, 1884. Agonium. Type.
cerevisiae, Balcke, 1884. Pediococcus.
chauvoei,[1] Arloing, 1887 (Bacillus). Butyribacillus. See also *Vibrion septique*.
chlorina, Lauterborn, 1913. Pelogloea. Type.
chlorinus Cohn, 1872. Micrococcus.
cho[illegible] [illegible]. 1854), Trevisan, 1889. Pacinia. See also Vibrio.

[1] [illegible]. (J. Bact., v. 5, No. 8, 1920, p. 222) place this species under *Cl*[illegible]

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cholerae (Koch), Buchner. Vibrio. Type.
cholerae, Koch, Buchner, Jensen (?), 1909. Liquidovibrio.
cholerae-asiaticae (Zopf, Flügge), Trevisan, 1889. Pacinia.
cholerae-gallinarum (Zopf), Trevisan, 1884. Octopsis. See also Pasteurella.
chroococcum, Beijerinck, 1901. Azotobacter. Type. See also Parachromatium.
cienkowskii, Trevisan, 1879. Mantegazzaea.
cienkowskii, Metchnikoff, 1889. Spirobacillus. Type.
cinnabareus, Flügge, 1886. Rhodococcus.
citreus, Vincenzi, 1897. Tetragenus.
citreus (Menge), Migula, 1894. Planococcus.
citreus, Unna and Tomasoli, 1889. Ascobacillus.
clathratiforme (Szafer), Lauterborn, 1913. Pelodictyon. Type.
clathratiformis, Szafer. Pelodictyon.
cohnii, Perty, 1852. Pelosigma. Spiromonas.
coli, Escherich, 1886. Bacterium (emendation of Winslow et al).
coli commune, Escherich, 1886. Aerobacter.
comma, Schröter, 1886. Microspira.
commune, Maassen, 1905. Semiclostridium. Type.
coralloides, Thaxter, 1892. Myxococcus.
coryzae, Klebs, 1887. Diplokokkus.
cristatus, Leidy, 1850. Arthromitus. Type.
crepusculum, Ehrenberg, 1838. Monas.
crocatus, Berkeley and Curtis, 1857. Chondromyces. Type.
crouposa, Trevisan, 1885. Klebsiella. Type.
cubica, van Tieghem, 1880. Punctula.
cumulus minor, Miller, 1892. Coccus.
cylindric, Ehrenberg, 1838. Bacterium.
delbrucki, Beijerinck (?), 1901. Lactobacillus.
denitrificans, Beijerinck 1904. Thiobacillus.
denitrificans, Burri and Stutzer, 1895. Denitromonas.
denitrificans agilis, Ampola and Garino, 1896. Denitrobacterium.
dentium, Hoelling (?), 1910. Fusiformis.
deses, Ehrenberg, 1832. Bacterium.
dichotoma, Cohn, 1873. Cladothrix. Type. See also Erysipelothrix.
diffluens, Müller, 1786. Proteus (an amoeba?).
diphtheriae (Klebs, 1883), Löffler, 1884, Migula. Corynebacterium.
discophora, Schwers, 1912. Megalothrix. Type.
distortus, Ducleaux, 1882. Tyrothrix.
divergens, Kützing. Leptomitus.
dunbari, Miquel and Cambier, 1902. Photospirillum.
duplex, Brussoff, 1916. Ferribacterium. Type.
duttoni, Novy and Knapp, 1906. Spiroschaudinnia.
edingtoni, Trevisan, 1889. Ascobacillus, Klebsiella.
elegans, Winogradsky, 1888. Thiodictyon.
enchelys, Ehrenberg (?), 1832. Bacterium.
epiphytica, Migula, 1895. Chlamydothrix.
equi, Rivolta, 1878 (Discomyces). Botryococcus, Botryomyces, Bollingera.
equi, Mori, 1913. Caryobacterium.
equorum, Trevisan, 1884. Octopsis.
erectus, Schröter, 1886. Cystobacter.
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erysipelatos, Rosenbach, 1884. Streptococcus.

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erysipelatosus, Klebs, 1887. Streptokokkus.
erysipeloides, Rosenbach, 1909. Erysipelothrix.
erysipeloidis, Trevisan, 1879. Babesia.
erythromyxa, Zopf, 1891. Rhodococcus.
erythrosporos (Cohn, 1879), Schröter, 1886. Streptobacter.
europea, Winogradsky, 1892. Nitrosomonas.
farcinica, Trevisan, 1889. Nocardia.
felis, Rivolta, 1887. Cocco-bacterium. Type.
fermentum, Beijerinck (?), 1901. Lactobacillus.
ferruginea, Ehrenberg, 1836. Gallionella, Chlamydothrix, Didymohelix (type), Gloesphaera, Gloeotila, Nocardia.
ferrugineum (Ehrenberg), Trevisan, 1889. Meloseira. See also Nodofolium.
ferrugineum, Ehrenberg (Ellis), 1907. Spirophyllum. Type.
filiformis, Ducleaux, 1882. Tyrothrix.
filiformans lodzensis, Bartoszewicz and Schwarzwasser, 1908. Tetradiplococcus.
filum, Morren, 1830. Bactrella.
finckleri (Koch, 1884), Schröter, 1886. Microspira.
fischeri, Beijerinck, 1889. Photobacterium.
fischeri, Küttner, 1895. Pyobacterium. Type.
fischeri, Küttner, 1895. Pyobacterium. Type. See also Eiterbacterium.
flaccidifex, Glaser and Chapman, 1912. Gyrococcus. Type.
flavescens, Arloing, 1889. Pneumococcus.
flexuosa, Müller, 1786. Vibrio. See also Melanella.
fluitans, Bigula, 1895. Chlamydothrix.
fluorescens (Flügge), Migula, Jensen, 1909. Liquidomonas.
fluorescens liquefaciens, Flügge, 1886 (Kruyff). Lipobacter. See also Liquidomonas.
fluorescens longum (Zimmermann) Fischer, 1895. Bactrillum.
foesteri, Cohn, 1875. Cohnistreptothrix. Type.
foesteri, Cohn, 1875 (Trevisan, 1889). Streptothrix. Type. See also Nocardia.
foetidum, Jacqué and Masay, 1912. Streptobacterium.
formae novae, Rullmann, 1897. Nitrosobacterium.
freudenreichii, Guillebeau (Micrococcus). See Karphococcus.
fulvus, Cohn, 1875 (Winslow and Rogers, 1906). Rhodococcus.
fulvus, Ehrenberg, 1828. Spirodiscus. Type.
fungorum, Linné. Chaos.
fusca, Schorler, 1904. Clonothrix. Type.
fuscum, Ehrenberg, 1832. Bacterium.
fuscus, Schröter, 1886. Cystobacter.
fusiformis (Hoelling]). 1910. Fusiformis.
gallinarum (Klein,) Blanchard, 1905. Spiroschaudinnia.
gallinarum. Swellengrebel, 1907. Borrelia. Type.
gelatinosa, Miyoshi, 1897. Thiosphaera. Type.
gelatinosa, Molisch, 1907. Rhodocystis. Type.
gelatinosa, Winogradsky, 1888. Thiothece.
germinans, Stutzer and Hartleb, 1901. Nitromicrobium.
gigantea, Miller. Rasmussenia.
giganteum, Molisch, 1907. Rhodospirillum.
gigas Billroth, 1874. Streptobacteria.
gi[illegible]ardii, Billroth, 1874. Streptobacteria.
[illegible] Tieghem, 1880. Punctula.

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glossophila, Trevisan, 1889. Dicoccia. Type.
gonorrhoeae, Salisbury, 1868. Crypta.
gonorrhoeae, Trevisan, 1889. Neisseria.
gonorrhoeae, (Neisser?) Migula, 1895. Gonococcus.
gonorrhoeae, Zopf, 1885. Merismopedia.
gonorrhoicus, Klebs, 1887. Diplokokkus.
gracile, Perty, 1852. Sporonema. Type.
grandis, Gross, 1911. Saprospira. Type.
granula, Winogradsky, 1888. Amoebobacter.
granulomatis, Beaufaire-Arago and Vianna, 1913. Calymmatobacterium.
gregarium, Cohn, 1873. Myconostoc. See also Spirosoma.
grevillii, Agardh, 1828. Haematococcus. Alga.
guilliermondi, Chatton and Perard, 1913. Oscillospira.
gutta-cerei, Arloing, 1889. Pneumococcus.
haeckeli, Wolff, 1907. Pedioplana. Type.
hartwigi, Frenzel, 1897. Modderula. Type.
hercynicum, Römer, 1845. Erebonema. See also Leucocystis.
hoffmanni, Gruber, 1891. Micromyces.
horkelii, Mayen, 1827. Actinomyce.
hortulensis, Beijerinck (?) 1900. Saccharobacter.
hyalina, Müller, 1786. Vibrio. See also Gonium, Lampropedia, Merismopedia, Streptothrix, and Chlamydothrix.
icterohaemorrhagiae, Inado and Ido, 1914. Leptospira.
icteroides, Noguchi, 1918. Leptospira.
imetropha, Sette, 1820. Zoagalactina.
imetrophus, Trevison, 1879. Zoagalactina.
immobilis, (Schattenfroh and Grasberger) Fischer, 1895. Paracloster.
inanis, Ehrenberg, 1828. Monas.
indicum, Beijerinck, 1889. Photobacterium.
influenzae, (Pfeiffer 1892) Lehmann and Neumann, 1896. Hemophilus.
infusionum, Ehrenberg (Palmella) 1838. Zoogloea.
insectorum, Robin, 1847. Leptothrix.
intracellularis (Weichselbaum) Kraus, 1913. Meningococcus. See also Meningokokkus.
intracellularis meningitidis, Weichselbaum (Diplococcus), 1887. Meningokokkus.
investans, Borzi, 1878. Ophyrothrix.
israeli, var. *spitzi*, Sampietro, 1908. Actinobacterium.
israeli, Kruse, 1896. Cohnistreptothrix.
japonicum, Kirchner, 1895. Rhizobacterium. Type.
jenensis, Ehrenberg, 1838. Ophidomonas. Type.
johnei, Klebs, 1887. Ascokokkus.
jonesi, Dutton, Todd and Tobey, 1906. Spiroschaudinnia.
jurgensi, Stempel, 1916. Strickeria.
klebsii, (Escherich) Miller, 1886. Helicobacterium.
kochii, Metchnikoff, 1888. Sclerothrix. Type.
komma (Schröter) Migula, 1894, variant of *comma* Schröter. See Microspira.
lactis, Beijerinck, 1901. Lactococcus.
lactis, Guillebeau, 1890. Galactobacterium.
lactis, Guillebeau, 1890. Chlorobacterium. Type.
lactis acidi, Liebmann, 1896. (Migula, v. 2, 1900, p. 405) or Leichmann (Troili-Peterson, 1903, p. 138). Brachybacterium.

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lactis acidi, Marpmann, 1886. Sphaerococcus. Type.
lactis aerogenes, Escherich, 1886. Aerobacter.
lactis viscosum, Adametz, 1891. Actinobacterium.
laevigata, Banks and Soland, 1769. Merista.
lagerheimii, Trevisan, 1889. Schuetzia.
laminariae Trevisan, 1889. Billetia. Type.
lanceolatus, Foa and Bordoni-Uffreduzi, 1888. Diplococcus. See also Meningococcus.
laughlini, Trevisan, 1889. Schuetzia.
lebensis, Rist and Khoury, 1902. Streptobacillus.
leguminosarum, Frank, 1890. Rhizobium. Type. See also Phytomyxa, Schinzia, Pseudorhizobium, Rhizobacterium and Rhizomonas.
lens, Müller, 1773. Monas.
leprae (Hansen, 1872), Lutz, 1886. Coccothrix.
leptomitiformis, Menenghini 1842 (?). Oscillaria. See also Beggiatoa.
lichenoides, Arloing, 1889. Pneumococcus.
lignieresi, Brumpt, 1910. Actinobacillus. Type.
lilacina, Trevisan, 1889. Cenomesia.
limicola, Nadson, 1906. Chlorobium. Type.
lineola, Müller, 1773. Vibrio. Type. See also Melanella, Zygobacterium and Zoogloea.
liquefaciens, Tataroff, 1891. Aerobacter.
liquefaciens bovis, Arloing, 1889. Pneumobacillus. Type. See also Pneumococcus.
littoralis, Rabenhorst (?). Merismopedia. See also Thiopedia.
littoralis, Oersted, 1840–41. Erythroconis.
luminosum, Beijerinck, 1889. Photobacterium.
luteola, Schmidle (Aphanothece). Schmidlea. Type.
luteum, Babès, 1890 (?). Ascobacterium. Type.
lycopersicum, Groenewege, 1912. Phytobacter.
magnus, Miller, 1888. Jodococcus.
major, Molisch, 1910. Siderocapsa.
malariae, Klebs and Tomassi. Coccothrix.
mallei, Löffler and Schütz, 1881. Corynebacterium.
mallei, [Löffler, 1886[1] (Bacillus)], Buchanan. Pfeiferella. Type.
marcescens, Bizio, 1827. Serratia. Type.
maxima, Trevisan, 1889. Rasmussenia.
megaterium, de Bary, 1884. Bactridium.
megatherium, de Bary, 1884 (Beijerinck). Saccharobacter.
melanogenum, Beijerinck (?), Acetobacter.
merismopocdioides, De Bary (?), 1884. Arthrobacterium.
mesenterioides, Cienkowski, 1878 (van Tieghem). Leuconostoc.
methanicus (Söhngen, 1906), Jensen. Methanomonas.
methanigenes, Jensen, 1909. Celluobacillus.
mica, Müller, 1773. Monas. Type.
minor, Molisch, 1907. Rhodococcus.
minutula, Brébissant. Meloseira.
mirabile, Buder, 1914. Chloronium. Type.
mirabilis, Hauser, 1885. Proteus.
mirabilis, West and Griffiths, 1909. Hillhousia.
mirifica, Rabenhorst, Palmella.
m (Rabenhorst), Trevisan, 1889. Palmella.

[1] Committee, Soc. Am. Bact., in J. Bact., v. 5, No. 3, Baltimore, 1920,

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mobiusii, Engler, 1883. Cladomyces. Type.
monadina, Bory de St. Vincent, 1824. Melanella.
monas (Müller), Ehrenberg. Bacterium.
moniliformis, Müller, 1783. Gaillonella.
mucor (Oersted, 1844), Trevisan. Leptotrichia, Leucothrix.
mucosum anaerobicum, Klinger, 1912. Cocobacterium. Type.
multiseptata, Engler, 1883. Phragmidiothrix.
multisporus, Dangeard, 1890–91. Eubacillus.
mülleri, Petschenko, 1911. Drepanospora.
muris (Hoelling), 1910. Fusiformis.
murisepticus, Rosenbach, 1909. Erysipelothrix.
mycetomi, Laveran. Madurella.
mycoides, Borrel, Dujardin-Beaumet, Jeantet and Jouan, 1910. Asterococcus. Type.
nana, Gross, 1911. Saprospira.
natans, Kützing, 1833. Sphaerotilus. Type.
neisseri, Lindau, 1898. Gonococcus.
nitidus, Leidy. Arthromitus.
nitrosomonas, Lehmann and Neumann, 1897 (?). Nitrosomonas.
nitrosum, Maggi, 1887. Zygobacterium.
nivea, Rabenhorst. Leptonema [alga].
nivea, Winogradsky, 1888. Thiothrix. Type.
nocardi, Haass (?), 1906. Actinocladothrix.
noltii, Agardh, 1828. Haematococcus. Alga.
nosconii viennensis, Billroth, 1874. Siphonomyxa.
nummuloides, Dillwyn, 1802 [Conferva, an algal genus]. See Gaillonella.
obermeieri, Cohn, 1875. Punctum.
ocellus, Müller, 1773. Monas.
ochracea (Leiblein), Kützing, 1843. Leptothrix. Type. See also Chlamydothrix, Nodofolium.
ochracea, Roth, 1797. Detoniella, Oscillatoria, Leptothrix.
ochraceus, Rosenthal. Micrococcus.
oedematis, Liborius, 1886. Vibrion septique.
oedematis-maligni, Hesse. Cornilia. See Clostridium and Vibrion.
okenii, Ehrenberg, 1838 (Monas). Chromatium. Type.
oligocarbophilus, Beijerinck and van Delden (Bacillus). Carboxydomonas.
ollare, Persoon, 1822. Mycoderma.
orbicularis, Ravenel. Micrococcus.
ostrajanini, Nedrigailov, 1907. Melococcus. Type.
ovatum, Lebert, 1856. Panhistophyton. Type. See also Bacteriopsis and Nosema.
ovina, Blanchard (1906). Sprioschaudinnia.
oxaliferum, Schewiakoff, 1893. Achromatium. Type. See also Modderula.
pallida, Schaudinn, 1904 [Spirochaete]. Spironema.
pallidum, Schaudinn, 1905. Treponema. Type. See also Spironema and Microspironema.
paludosum, Fischer, 1895. Plectridium.
palustris, Molisch, 1907. Rhodobaccillus. Type.
pantotrophus, Kaserer, 1905. Hydrogenomonas.
parasitica (Kützing) Trevisan. Leptotrichia.
parvus, Molisch, 1907. Rhodovibrio. Type.
parvus, Miller, 1888. Jodococcus.
parvus, Billroth, 1874. Ascococcus. Type.
pasteurianum, Hansen, 1879. Bacteriopsis.

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pasteuri, Miquel, 1889. Cornilia.
pasteurii, Miquel, 1889. Urobacillus. Type.
pastorianum, Hansen, 1879. Arthrobacterium.
pastorianus, van Laer, 1892. Saccharobacillus.
pastorianus, Beijerinck, 1898. Acetobacter.
pectinis, Gross, 1910. Cristispira. Type.
pellucidum, Fischer, 1894. Halibacterium.
pendens, Molisch, 1906. Rhodothece. Type.
pericardii, Billroth, 1874. Streptobacteria.
perlibratus (Beijerinck?). Diffusionsbacillus.
peroniella, Klein, 1889. Paraplectrum.
phosphorescens, Beijerinck, 1889. Photobacterium.
photometricum, Molisch, 1907. Rhodospirillum. Type.
pignacea, Mantegazza, 1851. Vibriocephalus. Type.
pituitoparus, Hohl, 1902. Karphococcus.
pleuro-pneumoniae, Schutz, 1887 (?). Diplostreptococcus.
plicatilis, Ehrenberg, 1834. Spirochaeta. Type. See also Spirulina.
pneumoniae, Weichselbaum, 1886. Diplococcus. See also Hyalococcus.
pneumoniae, Schröter, 1886 (Freidlander, 1882). Leucocystis.
pneumoniae-crouposae, Zopf. Klebsiella.
pneumonicus, Bonôme, 1888. Pseudodiplococcus. Type.
polymorphum, Fischer, 1894. Halibacterium.
polymorphus, Ducleaux, 1882. Actinobacter. Type.
polymyxa, Prazmowski, 1880. Granulobacter.
polyspora, Chatton and Perard, 1913. Metabacterium.
polyspora, Cohn, 1870. Crenothrix. Type.
porci, Rosenbach, 1909. Erysipelothrix.
prodigiosa, Ehrenberg, 1839. Palmella, Monas, Micrococcus.
prodigiosum. (Ehrenberg, 1839) Schröter, 1872. Bacteridium. See also Liquidobacterium.
prodigiosus (Ehrenberg, 1839), Flügge, Cohn. Coccobacterium. Type (?). See also Serratia.
prowazeki, da Rocha Lima, 1916. Rickettsia. Type. See also Dermacentroxenus.
pseudodiphtheriticum, Löffler, 1887. Corynebacterium.
pseudopulcher, Beijerinck, 1900. Proteobacter.
pseudo-termo, Fischer, 1895. Bactrillum.
pulmonis equi, Bollinger, 1869 (Zoogloeae). Botryococcus, Bollingera, Botryomyces.
punctata, Meyen, 1828. Merismopedia.
punctata, Trevisan, 1842. Beggiatoa.
punctum, Müller, 1786. Monas. See also Melanella and Bacterium.
punctum, Poulsen, 1879. Sarcinaglobulus. Type.
putrificus, Flügge, 1886. Putribacillus.
pyocyanea [Gessard, 1882; Migula, 1900, (Bacillus)] Jensen, 1908. Liquidomonas.
pyocyaneus (Gessard, 1882), Fischer. Bactrinium.
pyogenes, Rosenbach, 1884. Streuptococcus. Type. See also Pyococcus.
pyogenes, Rosenbach, 1884. Streptococcus, Albococcus. Type.
pyogenes albus, Rosenbach, 1884. Staphylococcus.
pyogenes aureus, Rosenbach, 1884. Staphylococcus.
pyosepticus, Fortineau, 1905. Erythrobacillus.
radians (Kützing), Trevisan, 1889. Leptotrichia.
radiatus, Luderitz, 1889. Cornilia.
radicicola, Beijerinck (Bacterium), 1888. Rhizomonas, Rhizobium.

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ramigera (Itzigsohn), Trevisan, 1889. Winogradsky.
ramosa, Famintzin, 1891. Nevskia. Type.
ramosa, Metchnikoff, 1888. Pasteuria. Type. See also Nevskia.
ramosum, Hartleb, 1900. Pseudorhizobium.
rasmusseni, Trevisan, 1885. Bacteriopsis.
recurrentis (Lebert,[1] 1874). Spiroschaudinnia.
reitenbachii, Caspary, 1874. Merismopedium.
rhenanus, Migula, 1899–1900. Albococcus.
rhodochrous, Zopf, 1891. Rhodococcus.
rhusiopathiae, Rosenbach, 1909. Erysipelothrix.
rigidula (Kützing), Trevisan, 1889. Leptomitus, and Leptotrichia.
rosa, van Tieghem 1880. Punctula.
rosea, Kützing, 1837. Michrohaloa. See also Lamprocystis.
rosea, Cohn, 1875. Rhabdomonas. Type. See also Rhabdochromatium.
rosea[2] (Schröter), Winogradsky. Thiosarcina. Type.
rosea, Winogradsky, 1888. Thiopedia. Erythroconis.
roseo-persicina. Kützing, Schröter (Lamprocystis). Clathrocystis. and Cohnia.
roseo-persicina. Winogradsky, 1888. Thiocapsa. Type.
roseo-persicinus. Rabenhorst (Pleurococcus), Clathrococcus. Type (?). See also Protococcus, Lamprocystis, and Cohnia.
roseum, Miyoshi, 1897. Thioderma. Type.
roseum, Fischer, 1894. Halibacterium.
roseum, Winogradsky, 1888. Rhabdochromatium.
roseum, Lauterborn, 1913. Pelochromatium. Type.
roseum, Winogradsky, 1888. Amoebobacter. Type.
roseus, Flügge, 1886. Rhodococcus.
rotans, Lauterborn, 1906. Pelosphaera.
ruber, Winogradsky, 1888. Thiopolycoccus.
rubescens, Ray Lankester (Bacterium). See Lamprocystis and Clathrocystis.
rubescens, Thaxter, 1892. Myxococcus.
rubrofuscum, Fischer, 1894. Halibacterium.
rubrum, Miyoshi, 1897. Thioderma.
rufa, Winogradsky, 1888. Thiocystis.
rugula, Müller, 1786. Vibrio. See also Melanella.
saccharobutyricum, Beijerinck (?) 1893. Granulobacter. See also Granulobacillus.
saccharobutyricus, von Klecki, 1896. Granulobacillus.
saccharobutyricus immobilis liquefaciens, Schattenfroh and Grassberger, 1899. Granulobacillus.
saccharobutyricus mobilis nonliquefaciens, Schattenfroh and Grassberger, 1899. Granulobacillus.
saccharomyces, Rougentzoff, 1914. Enterococcus.
saltans, Mühlhäuser, 1884. Punctum. Type.
sanguineum, (Ehrenberg) Winogradsky, 1888. Thiospirillum.
sanguineus, Agardh, 1828. Haematococcus.
scarlatinosa, Trevisan, 1889. Perroncitoa. Type.
schenckii [Fungus] Sporothrix.
schirokikhi, Jensen (?) 1908. Liquidomonas.
schmidlei, Lauterborn, 1907. Thioploca. Type.
scintillans, Ehrenberg, Bacterium.

[1] According to Manson, 1907, p. 833.
[2] According to Buchanan, J. Bact., v. 3, No. 5, p. 467.

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scissipara, Roze, 1898. Chatinella.
seborrhoeae (Sabouraud) Schamberg, 1902. Microbacillus.
septica, Billroth, 1874. Coccobacteria.
septique, Pasteur. Vibrion. See also Clostridium.
septicum, Beijerinck, 1900. Proteobacter.
serpens, Müller, 1786. Vibrio.
simplex, Ehrenberg, 1828. Monas, Bacterium.
simplex, Thaxter, 1892. Myxococcus.
somaliensis, Brumpt, 1906. Indiellopsis.
spinosus, Luderitz, 1889. Cornilia.
spirillum, Müller, 1786. Vibrio. See also Melanella and Spirillum.
spissa (Rabenhorst 1865), Trevisan. Leptotrichia.
spitzi, Lignières and Spitz. Actinobacterium.
splendidum, Beijerinck, 1900. Photobacter.
stylopygae, Petschenko, 1908. Bacillopsis.
subflava, Ravenel, Sarcina.
subtile (Ehrenberg, Cohn) Fischer, 1895. Bactridium.
subtilis (Ehrenberg, 1833), Cohn, 1872. Bacillus.
sulfurea, van Tieghem, 1880. Polybacteria.
suspensa, Molisch, 1906. Rhodocapsa. Type.
synovialis, Chantemesse, 1917. Mycobacillus.
synxanthus, Ehrenberg, 1840. Bacteriopsis, Vibrio.
syphilitica, Salisbury, 1868. Crypta.
syphiliticum, Escherich (?), 1886. Helicomonas. Helikomonas.
taeniata, Lauterborn, 1913. Peloploca.
tardissimus, Altana, 1909. Tetragenus.
tenuis, Ducleaux, 1882. Tyrothrix.
tenuis, Winogradsky, 1888. Thiothrix.
tenuissima, Winogradsky, 1888. Thiothrix.
teres (von Flotow), Cohn. Zoogloea.
termitidis, Hoelling, 1910. Fusiformis.
termo (Dujardin), Cohn, 1853. Zoogloea.
termo, Müller, 1773, Monas. Bacterium.
termo (?), Bactrillum.
termo (Ehrenberg, Cohn). Bacterium, emend. Smith. Type.
tetani (Nicolaier, 1884), Fischer. Plectridium. Type.
tetragena (Mendoza). Migula. Sarcina.
tetragenus, Gaffky, 1883 (or 1881?). Gaffkya.
tetragenus mobilis ventriculi, Mendoza, 1889. Planomerista.
theileri, Laveran, 1904. Spiroschaudinnia.
thermophilum, Ambroz, 1913. Deazotonitraazobacterium, Deazotonitranitriazobacterium, Deazotonitriazobacterium.
thioparus, Beijerinck, 1904. Thiobacillus.
thuretiana, Borzi, 1878. Ophyrothrix, Leptotrichia.
treubii, Molisch, 1910. Siderocapsa.
tremulans, Ehrenberg, 1830. Bacterium, Vibrio.
triloculare, Ehrenberg, 1828. Bacterium. Type. See also Mantegazzaea.
tuberculorum, Vuillemin, 1888. Cladochytrium.
tuberculosis, Koch, 1882. Mycobacterium. See also Coccothrix.
tumescens (Zopf) Trevisan, 1885. Zopfiella.
typhi,[1] Eberthella. Type.
typ[illegible]alis.[1] Bactridium.

[illegible]ribed the organism causing typhoid fever, but he did not name the
[illegible]d an organism under the name *Bacillus typhosus* (Arch. f. Exp.

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ulceris mollis, Unna, 1892. Streptobacillus.
ulvina, van Tieghem, 1880. Ascobacteria. Type.
undula, Müller, 1773. Vibrio, Bactrella.
undula, (Müller) Ehrenberg. Spirillum. See also Vibrio.
undulata, Lauterborn, 1913. Peloploca.
ureae, Cohn, 1872. Micrococcus. Bacteriopsis. See also Merista.
urosporae, Lagerheim, 1900. Sarcinastrum. Type.
vaccinae, Cohn, 1872. Microsphaera. Type.
vandellii, Menenghini. Hygrocrocis.
variabilis, (Rasmussen) Trevisan, 1889. Rasmussenia.
variolae, Klebs, 1887. Tetrakokkus.
vejdovskii, Dobell, 1911. Paraspirillum.
ventriculi, Goodsir, 1842. Sarcina. See also Merismopedia.
ventriculi, (Mendoza) Vuillemin, 1913. Planomerista. Type.
versicolor, Guillebeau, 1890. Galactococcus.
violacea, Schröter, 1880. Pseudomonas. Type.
violacea, Winogradsky, 1888. Thiocystis.
violaceum, Bergonzini, 1881. Cromobacterium. Type.
violaceus, Bergonzini, 1881. Cromococcus. Type.
violascens, Perty, 1852. Chromatium.
virescens, Thaxter, 1892. Myxococcus.
vitellinum, Link, 1795. Polyangium. Type. See also Cystobacter.
volubilis, Perty, 1852. Spiromonas.
volutans, Ehrenberg, 1830. Spirillum. Type.
volutans, Hinze, 1903. Thiophysa. Type.
vulgare, Stutzer and Hartleb, 1901. Hyphomicrobium. Type.
vulgare, (Hauser) Jensen, 1909. Liquidobacterium.
vulgaris, Hauser, 1885. Proteus. Type. See also Liquidobacterium.
vulgaris, Jensen, 1909. Putribacillus.
vulgaris, Tsiklinsky, 1898. Thermoactinomyces.
weichselbaumii, Trevisan. Diplococcus.
weissii, Perty, 1852. Chromatium.
welchii,[1] Migula (Bacillus). See Vibrion septique, and Clostridium.
winogradskyi, Committee Am. Bact. Soc., 1917. Nitrobacter. Type.
winogradskii, (Omelianski) Wislouch, 1914. Thiospira.
xanthogenicus, Freire, 1885. Cryptococcus.
xanthopyreticus, Trevisan, 1889. Streptococcus, Babesia.
xerosis, Neisser and Kuschbert, 1883. Corynebacterium.
xylinum, Brown, 1886. Acetobacterium. Type.
zenkeri, Hauser, 1885. Proteus.
zopfii, Kurth, 1883. Kurthia. Type. See Zopfius.
zopfii, Kurth, 1883. Arthrobacterium. See also Helikobacterium.
zymogenes, Biedert, 1885. Kokkobacillus.

Path. u. Pharm., v. 12, 1879-80, p. 234), which Eberth (Virchow's Archiv., v. 83, 1881, p. 486, and idem, v. 81, 1880, p. 58) states is the same organism as that described by him and which he speaks of as "typhusbacillen," etc. Gaffky (Mitt. aus dem Kais. Gesundheits. Struck, v. 2, Berlin, 1884, p. 385) in reviewing the work done on this disease states that Letzerich (Archiv. f. Exp. Path. u. Pharm., v. 14, h. 3, 1883) considered that his *Micrococcus typhi abdominalis* might really be the same as Klebs's *Bacillus typhosus*. One of the earliest references found for *Bacillus typhi* is in Migula's paper in Engler and Prantl (Die Naturl. Pflanz. Lief. 129, 1 Teil, 1 Abt. *a*, Bog. 1-3, Leipzig, 1896, p. 26), where he gives the name *Bacillus typhi* Gaffky. I have been unable to find Gaffky's use of this species name. *Bacillus typhosus* Klebs is the earliest name I have succeeded in locating, though a complete search has not been made since the object in view is to determine the authorship of genera rather than species

[1] Com. Soc. Am. Bact. (J. Bact., v. 5, No. 3, 1920, p. 222) place this species under *clostridium*.

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HYGIENIC LABORATORY BULLETINS OF THE PUBLIC HEALTH SERVICE.

The hygienic laboratory was established in New York, at the Marine Hospital on Staten Island, August, 1887. It was transferred to Washington, with quarters in the Butler Building, June 11, 1891, and a new laboratory building, located in Washington, was authorized by act of Congress March 3, 1901.

Of the bulletins published by the laboratory since its establishment, copies of the following are available for distribution and may be obtained without cost by applying to the Surgeon General, United States Public Health Service, Washington, D. C.

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No. 44.—Report No. 2 on the origin and prevalence of typhoid fever in the District of Columbia, 1907. By M. J. Rosenau, L. L. Lumsden, and Joseph H. Kastle.

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TREASURY DEPARTMENT
UNITED STATES PUBLIC HEALTH SERVICE

HYGIENIC LABORATORY—BULLETIN No. 122
JULY, 1920

I. DETERIORATION OF TYPHOID VACCINE

By G. W. McCOY and IDA A. BENGTSON

II. STANDARDIZATION OF GAS GANGRENE ANTITOXIN

By IDA A. BENGTSON

III. POTENCY OF BACTERIAL VACCINES SUSPENDED IN OIL (LIPOVACCINES)

By IDA A. BENGTSON

WASHINGTON
GOVERNMENT PRINTING OFFICE
1920

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United States Public Health Service.

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CONTENTS.

	Page.
I. Deterioration of typhoid vaccine	7
II. Standardization of gas gangrene antitoxin	13
Introduction	13
Organisms concerned in gas gangrene	15
Toxin and antitoxin of B. perfringens (B. welchii)	18
Method of producing toxin	18
Standardization of antitoxin	20
Deterioration of fluid toxin	22
Effect of temperature, light, reaction	25
Precipitated toxin	27
Toxin and antitoxin of vibrion septique	28
Toxin of B. oedematiens	30
III. Potency of bacterial vaccines suspended in oil (lipovaccines)	33
Typhoid-paratyphoid oil vaccines	33
Pneumococcus oil vaccines	36
Conclusions	42

ILLUSTRATIONS.

CHART A.	Deterioration of typhoid vaccine at various temperatures	11
1.	Perfringens toxin 14B, test dose	23
2.	Perfringens toxin 6. Deterioration	24
3.	Perfringens toxin 21A. Deterioration	24
4.	Perfringens toxin 21A, test dose	25

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I. DETERIORATION OF TYPHOID VACCINE.[a]

By G. W. McCoy, *Director*, and Ida A. Bengtson, *Bacteriologist*, Hygienic Laboratory, U. S. Public Health Service, Washington, D. C.

An experiment was carried out over a period of two and one-half years to determine the effect of various storage temperatures on the agglutinin-producing properties of typhoid vaccine.

The vaccine with which the tests were carried out was one made according to the standard Hygienic Laboratory method,[1] in which the Rawling strain of *B. typhosus* was the organism used. The vaccine contained 1,000,000,000 organisms per c. c. and was preserved with 0.3 per cent trikresol. The finished product was filled into 1-c. c. ampoules, which were sealed and stored at four different temperatures, viz, 5° C., refrigerator temperature; 10–15° C., cold-room temperature; 20–30° C., room temperature; and 37° C., incubator temperature. Rabbits were inoculated at stated periods in accordance with the Hygienic Laboratory method of testing typhoid vaccine,[1] the vaccine being administered subcutaneously in three doses, of ½ c. c., 1 c. c., and 1 c. c., at four or five day intervals and the rabbits bled about five days after the last injection. At each test three rabbits were always injected with each vaccine under test, and three control rabbits were injected with a Hygienic Laboratory vaccine of recent date, except in the tests made after three and six months' storage. Some of the rabbits died before immunization was completed.

The following protocols indicate the deterioration taking place during the time the vaccines were studied, as shown by the agglutination reactions of the serums of the vaccinated rabbits against a suspension of the Rawling strain. The culture was grown on agar slants or agar contained in Blake bottles, incubated 24 hours and the saline suspension of this growth made up to a turbidity corresponding to approximately 1,000 parts per million of silica in distilled water, making with the serum dilutions used a final dilution of 500 parts per million.

AGGLUTINATION AT BEGINNING OF TEST.

[4 indicates complete agglutination with supernatant fluid perfectly clear; 3, marked agglutination with supernatant fluid slightly turbid; 2, definite agglutination with supernatant fluid more turbid than in 3; 1, slight agglutination.]

	1/50	1/100	1/200	1/400	1/800	1/1,600 [2]
Rabbit 1	4	3	2	2	2	1
Rabbit 2	4	4	3	2	2	1
Rabbit 3	4	3	3	2	2	2

[a] Manuscript submitted Nov. 1, 1919.
[1] McCoy, G. W., Hygienic Laboratory Bulletin No. 110.
[2] Final dilutions of serum.

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3 MONTHS' STORAGE.

	1/50	1/100	1/200	1/400	1/800	1/1,600
5°.						
Rabbit 1	4	3	3	3	2	1
Rabbit 2	4	4	3	3	3	2
10–15°.						
Rabbit 1	4	4	3	2	1	1
Rabbit 2	4	3	3	2	1	1
Rabbit 3	4	3	2	1	1	1
20–30°.						
Rabbit 1	4	3	3	2	1	1
Rabbit 2	4	4	3	3	2	1
Rabbit 3	4	4	3	2	2	1
37°.						
Rabbit 1	4	4	4	3	2	1
Rabbit 2	4	4	3	3	2	1
Rabbit 3	4	4	4	3	2	2

6 MONTHS' STORAGE.

5°.						
Rabbit 1	4	4	4	3	2	1
Rabbit 2	4	4	4	4	4	2
Rabbit 3	4	4	4	3	2	1
10–15°.						
Rabbit 1	4	4	3	2	1	1
Rabbit 2	4	4	3	2	2	1
Rabbit 3	4	4	3	2	1	1
20–30°.						
Rabbit 1	4	4	3	2	1	0
Rabbit 2	4	4	3	1	0	0
Rabbit 3	4	4	3	2	1	0
37°.						
Rabbit 1	4	4	4	3	1	0
Rabbit 2	4	4	4	2	1	0

9 MONTHS' STORAGE.

5°.						
Rabbit 1	4	4	4	4	3	2
Rabbit 2	4	4	4	4	2	1
Rabbit 3	4	4	4	4	2	1
10–15°.						
Rabbit 1	4	4	4	4	3	3
Rabbit 2	4	4	4	4	3	3
20–30°.						
Rabbit 1	3	3	2	1	0	0
Rabbit 2	4	4	3	2	1	0
Rabbit 3	4	4	4	3	2	1
37°.						
Rabbit 1	2	1	1	0	0	0
Rabbit 2	4	4	3	2	1	0
CONTROL VACCINE.						
Rabbit 1	4	4	3	2	0	0
Rabbit 2	4	4	4	4	3	2
Rabbit 3	4	4	4	3	2	1

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12 MONTHS' STORAGE.

	1/50	1/100	1/200	1/400	1/800	1/1,600
5°.						
Rabbit 1	4	3	2	2	1	0
Rabbit 2	4	3	2	1	1	0
Rabbit 3	4	2	1	0	0	0
10–15°.						
Rabbit 1	4	3	2	1	1	0
Rabbit 2	4	3	2	1	0	0
Rabbit 3	4	4	3	2	1	0
20–30°.						
Rabbit 1	3	3	2	1	0	0
Rabbit 2	2	1	1	0	0	0
Rabbit 3	4	3	2	1	0	0
37°.						
Rabbit 1	2	1	1	0	0	0
Rabbit 2	2	1	1	0	0	0
Rabbit 3	2	1	1	0	0	0
CONTROL VACCINE.						
Rabbit 1	4	4	3	2	1	0

15 MONTHS' STORAGE.

5°.						
Rabbit 1	4	3	2	2	1	0
Rabbit 2	4	3	2	2	1	0
10–15°.						
Rabbit 1	4	4	4	3	2	2
Rabbit 2	3	3	2	2	1	0
20–30°.						
Rabbit 1	4	3	2	2	1	0
Rabbit 2	4	3	2	2	0	0
Rabbit 3	4	3	2	1	1	0
37°.						
Rabbit 1	2	1	0	0	0	0
Rabbit 2	1	0	0	0	0	0
Rabbit 3	1	1	0	0	0	0
CONTROL VACCINE.						
Rabbit 1	4	3	3	2	0	0
Rabbit 2	4	3	2	2	1	0

18 MONTHS' STORAGE.

5°.						
Rabbit 1	4	3	2	1	0	0
Rabbit 2	4	3	3	3	2	0
10–15°.						
Rabbit 1	3	2	1	0	0	0
Rabbit 2	4	4	3	2	1	0
Rabbit 3	4	4	3	3	3	2
20–30°.						
Rabbit 1	4	4	3	1	0	0
Rabbit 2	4	3	3	3	2	0
Rabbit 3	3	3	2	1	0	0
37°.						
Rabbit 1	1	0	0	0	0	0
Rabbit 2	1	0	0	0	0	0
Rabbit 3	1	0	0	0	0	0
CONTROL VACCINE.						
Rabbit 1	4	4	3	3	3	2
Rabbit 2	4	4	4	3	2	1
Rabbit 3	4	3	2	2	1	0

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24 MONTHS' STORAGE.

	1/50	1/100	1/200	1/400	1/800	1/1,600
5°.						
Rabbit 1	2	1	0	0	0	0
Rabbit 2	3	2	1	0	0	0
Rabbit 3	3	3	2	1	0	0
10–15°.						
Rabbit 1	4	3	1	1	0	0
20–30°.						
Rabbit 1	4	2	0	0	0	0
Rabbit 2	3	3	2	1	0	0
Rabbit 3	4	3	0	0	0	0
CONTROL VACCINE.						
Rabbit 1	4	4	4	3	1	0
Rabbit 2	3	2	1	0	0	0

31 MONTHS' STORAGE.

10–15°.						
Rabbit 1	4	2	1	0	0	0
Rabbit 2	4	3	1	0	0	0
20–30°.						
Rabbit 1	3	1	0	0	0	0
Rabbit 2	4	3	2	1	0	0
Rabbit 3	2	1	0	0	0	0
CONTROL VACCINE.						
Rabbit 1	4	3	3	3	1	0
Rabbit 2	4	4	4	3	3	0
Rabbit 3	4	3	3	3	2	0

32 MONTHS' STORAGE.

10–15°.						
Rabbit 1	4	3	3	1	0	0
Rabbit 2	4	4	2	0	0	0
CONTROL VACCINE.						
Rabbit 1	4	4	4	3	1	0
Rabbit 2	4	4	4	4	3	0
Rabbit 3	4	4	4	4	3	1

The graphs (Chart A) have been made by plotting points representing averages of the results obtained in the agglutination tests with the serums of each group of three rabbits against the suspensions of cultures. The approximate vanishing points of agglutination or those which by our method of reading would be recorded by 1+ are represented on the curve.

The curves as plotted from these results show that the highest temperatures are most detrimental to the vaccine. While the vaccine stored at 5° and 10–15° did not show any appreciable deterioration in 6 months, the vaccine stored at 37° showed a marked falling off in potency, which continued at a rapid rate, so that in 18 months this vaccine was practically without effect on rabbits. The vaccine stored at room temperature had deteriorated more than the vaccine

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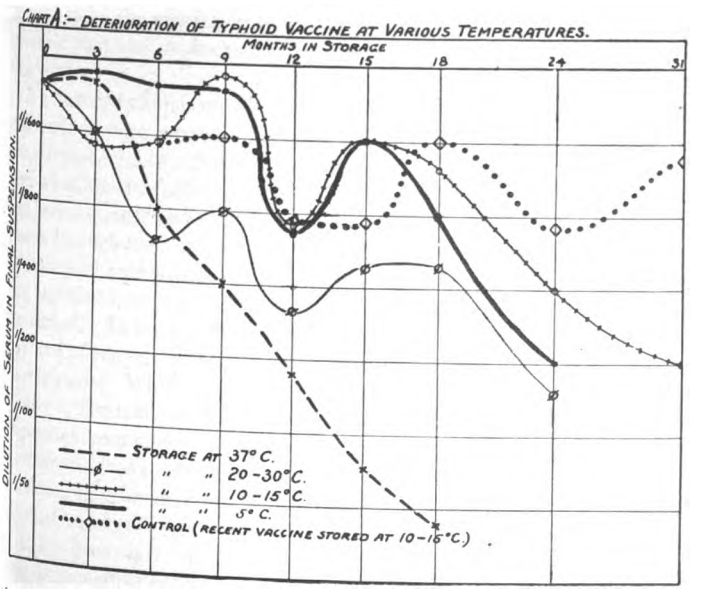
stored at the lower temperatures in 6 months and the curve continues below these two throughout the period of the test, though not falling off as abruptly as the curve representing the 37° storage.

In the case of the vaccines stored at 5° and 10–15° the effects of length of storage did not begin to be very apparent until after 18 months. By the time 24 months had elapsed the vaccine stored at 5° did not produce agglutinins in the rabbit serum which could be detected above a dilution of 1/200, and the one stored at 10–15° was of about the same strength, in contrast to a recently prepared vaccine which produced agglutinins, discernible in 1/800 dilutions of the serum. The experiment with the vaccine stored at 5° was discon-



tinued at the end of 24 months. The vaccine stored at 10–15°, at the end of 31 months, showed agglutinin production in the serum in a dilution of 1/200, and the test was repeated a month later and showed approximately the same result, the serum from the control vaccine showing agglutination between the dilutions 1/800 and 1/1,600 in both tests.

The results obtained indicate that the rapidity of deterioration is in direct proportion to the temperature above 15° C. The vaccine stored at 5° C. apparently deteriorated more rapidly than the one stored at 10–15°, but it is possible that if the serum from more rabbits had been available it would have been found that the difference

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between the two curves would not have been as much as indicated by the diagram.

In the absence of more trustworthy tests for the determination of the potency of typhoid vaccine, we are compelled to rely on the determination of the agglutinin-producing properties as a measure of the probable potency of the vaccine and on the loss of this property for a measure of the loss of potency. The results of the work related indicate therefore that a storage temperature of not more than 15° C. is necessary to maintain typhoid vaccine at its maximum potency for the greatest length of time.

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II. STANDARDIZATION OF GAS GANGRENE ANTITOXIN.

By IDA A. BENGTSON, *Bacteriologist*, U. S. Public Health Service.

Antiserums for the various anaerobic organisms associated with gas gangrene have been used to some extent to prevent development of this complication of wounds, and, to a less extent, as a therapeutic measure. Though the exact value of these serums for prophylactic and curative purposes remains to be established it became necessary to undertake the studies in standardization which are reported here in order that the products used might be as potent and uniform as practicable.

A number of studies on the subject of the bacterial flora of gangrenous wounds were carried on during the World War of 1914–18, with the purpose of determining which organisms are the causative agents and what are the factors concerned in producing the symptoms. It has been a question whether the injurious effects produced are brought about through mechanical effects due to excessive amounts of gas or to increased acid produced as a result of the metabolic activities of the organisms, or whether true toxins formed by the organisms are concerned. As a result of the work done the conception of the etiology and of the nature of gas gangrene has been materially altered in recent years. While all of the aspects of the subject are not as yet clearly understood, it has been demonstrated that certain anaerobic organisms commonly found in the gangrenous wounds are toxin formers and that the toxins formed are important factors in the effects produced in gas gangrene. Work has thus been directed toward the production of antitoxic sera to be used for prophylaxis and treatment.

It has been shown that not only one species of organism but several or numerous species may be present in gangrenous wounds and investigations have been undertaken to determine which of these are the active toxin producers. The subject thus becomes a very complex one.

In France until recently the *Vibrion septique* of Pasteur was considered of primary importance in gaseous infections, and little importance was attached to any other of the anaerobic organisms described. It was only with the new interest aroused in the study of gas gangrene in 1914 that the organism *B. perfringens* was considered of special significance.

In Germany the bacillus of malignant oedema, described in 1881 by Koch, who considered it identical with Pasteur's *Vibrion septique*,

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first received attention in connection with the etiology of gangrenous wounds. Though the organism of malignant oedema is usually connected with animal disease, it was considered for a long time in the light of the work of Koch, Pasteur, and Chauveau and Arloing that the human emphysematous gangrene and the malignant oedema of animals were one and the same disease and caused by the same organism, and until 1893 gangrenous septicemia of French authors and the German malignant oedema were practically synonymous terms for the affection. The identity of Pasteur's *Vibrion septique* and Koch's *B. oedematis maligni* was never definitely established, however, and later studies indicate that they are different organisms, or at least that many of the laboratory cultures now known as *B. oedematis maligni* are not the same as the *Vibrion septique* studied in connection with gas gangrene during the late war. This view is not, however, accepted by all workers.

The discovery of a new anaerobic organism in 1892 by Welch and Nuttall in the blood and organs of a cadaver eight hours after death from aortic aneurysm marked the beginning of a new epoch. The organism of Welch and Nuttall was named by them *B. aerogenes capsulatus* and has also been designated as *B. welchii* by other writers In 1893 Fraenkel isolated a similar organism from several cases of gaseous phlegmons which he called *B. phlegmones emphysematosæ*. He later acknowledged his organism to be identical with that of Welch, though it still is spoken of as Fraenkel's bacillus in German literature. In France it appears that the work of Welch was overlooked and Veillon and Zuber, 1898, described an organism identical with Welch's *B. aerogenes capsulatus* from several different pathological processes which they designated *B. perfringens*.[a]

In England during the period following 1892 and up to 1908 very little was published on the subject of gas gangrene and there are only a few scattered cases reported in which the bacillus of malignant oedema was considered the causal agent.

Von Hibler in 1899 published an extensive investigation of the anaerobic bacteria concerned in infections of man and animals and this work was revised and extended in 1908. A number of points are cleared up in the latter work and the whole subject of the relation

[a] The nomenclature of this organism is in a state of great confusion. In this country it has recently been almost universally known as *Bacillus welchii* and this name has also been used by English workers. The terms *Bacillus aerogenes capsulatus* Welch and Nuttall, 1892, and *Bacillus phlegmones emphysematosæ* Fraenkel, 1893, being trinomials are invalid. *Bacterium aerogenes* is valid for another organism and much confusion would result if the name *Bacillus aerogenes* were adopted. *Bacillus capsulatus* is also invalid on grounds of priority. *Bacillus emphysematosus* was used by Kruse in 1896 and *Bacterium emphysematosum* (Kruse) was adopted by Migula in 1900 for Fraenkel's organism, but Kruse includes *Bacillus aerogenes capsulatus* and Migula *Bacterium welchii* as different species. Other names have also been used for identical or closely related species, and in view of the uncertainty existing in the identification and nomenclature of these forms the name *Bacillus perfringens*, Veillon and Zuber, 1898, the first proposed binomial in use for this organism at the present time, has been adopted in this paper. These authors give a complete and accurate description of the organism.

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of pathogenic anaerobes to disease established on a somewhat better basis than had hitherto been possible. On the authority of v. Hibler's work, v. Werdth recognizes two types of gaseous infections: (1) Malignant oedema, in which the organism concerned is *B. oedematis maligni* (bacillus X of Hibler), and (2) gas gangrene (Gasbrand), in which *B. perfringens* and numerous other anaerobes and some aerobes are concerned.

V. Hibler's classification of anaerobes distinguishes between the bacillus of Ghon and Sachs (Pasteur's *Vibrion septique*), which is a nonproteolytic organism, and his own No. X, *B. oedematis maligni*, which is a proteolytic organism. This is apparently a valid distinction, and it would appear therefore that the organism now recognized as *B. oedematis maligni* Koch is a different organism from Pasteur's *Vibrion septique*.

At the beginning of the war the study of the flora of war wounds was undertaken in both France and England. With the progress of the work, two facts stood out prominently: (1) That *numerous* anaerobic organisms are concerned in gas gangrene, and (2) that it is difficult to separate these organisms in pure culture and to determine which are of chief etiological importance. The work which has been accomplished serves to emphasize the fact that the problem is a very complex one and that we do not know yet the true nature of the infection. There is still much confusion in the identification of the organisms concerned, and the same organism is described under various names by different authors. The principal difficulty lies in the fact, as has been just stated, that the separation of anaerobes is a matter requiring great care, and it is probable that considerable amount of work has been done with mixed cultures. The isolation of one organism, *B. perfringens*, in pure culture has been definitely accomplished, and it is acknowledged by practically all workers that this organism is found most frequently of all the anaerobes in gangrenous wounds. As to the relative frequency of occurrence and identification of the other organisms concerned there is still some question.

The work in France has been carried on principally by Weinberg and Séguin, and Jouan of the Pasteur Institute and by Sacquépée. The first two authors studied the bacterial flora of 126 cases of gas gangrene and gaseous phlegmons and as the result of their work state that 12 species of anaerobes are concerned in gas gangrene. Eight of these had been previously recognized and four are new species. The three organisms to which they assign the principal rôle are *B. perfringens*, *B. oedematiens*, and *Vibrion septique*. *B. oedematiens* is a new species isolated by them which produces a very potent toxin, and *Vibrion septique* is apparently the same organism as that originally described by Pasteur. In addition to these,

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B. sporogenes and *B. fallax* were present frequently; in fact, these occurred more often than the *Vibrion septique*, but the authors consider them of less importance from the pathogenic viewpoint than the three mentioned. *B. sporogenes* was next in frequency of occurrence to *B. perfringens*, but it produces a less potent toxin. This organism, which is motile, is characterized by its active proteolytic power and is usually associated with the putrid forms of gas gangrene. It has been confused with Pasteur's *Vibrion septique*.

B. fallax, a new species isolated by Weinberg, resembles *B. perfringens*. This author states that the organism produces a feeble toxin, 1–2 c. c. injected intravenously causing the death of 300–500 gram guinea pigs.

In addition to these five organisms a number of others of less frequent occurrence, including *B. putrificus* (Bienstock), *B. tertius* (Henry), *B. bifermentans* (Tissier and Martelly), *B. aerofoetidus* (Weinberg and Séguin), and *B. histolyticus* (Weinberg and Séguin), are considered as concerned in gas gangrene by Weinberg and Séguin. Sacquépée has described an organism occurring in gas gangrene which was first designated by him as *B. d'Œdème gazeuse malin* and later as *B. bellonensis;* in some of the descriptions this appears closely related to *B. oedematiens*, but the exact relationship of the organisms is somewhat obscure.

Much of the work done in Great Britain has been concerned with the identification of the various organisms present in gas gangrene and on studies of the biochemical properties of these organisms. The first report of this work was made by Miss Robertson of the Lister Institute who examined wound material and isolated as the three most frequently occurring organisms, *B. perfringens*, *B. odematis maligni* and an organism closely resembling v. Hibler's bacillus No. IX. Weinberg questions the identification of *B. oedematis maligni* in this study, and Henry in a later study classifies this group of organisms which are motile and proteolytic under the title *B. sporogenes*. The third group described by Miss Robertson became *B. tertius* of Henry, so named because it was third in frequency of occurrence. This organism was found on only one or two occasions by Weinberg and Séguin, and is considered of minor importance by them as it was not found to be pathogenic for guinea pigs. On the other hand, the organism *B. oedematiens*, which Weinberg and Séguin placed as third in frequency of occurrence in gangrenous wounds examined by them, was not isolated by Henry, but was later isolated by another English worker, Dalyell.

As the matter stands now it appears therefore that *B. perfringens* is most frequently present in war wounds and *B. sporogenes* second. *B. oedematiens* has been found to be third in frequency of occurrence, according to Weinberg and Séguin, and produces the most powerful

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toxin of any of the anaerobes concerned in gas gangrene. *Vibiour septique* also occurs frequently.

The results of the investigations of the French workers on the etiology of gas gangrene have in the main been accepted in England and in this country. With the fact established that the organism *B. perfringens* is present in the great majority of gangrenous wounds, and that *B. oedematiens* and *Vibrion septique* are also present in a certain percentage of such wounds, and that all three are toxin producers, attention has been directed toward the preparation of antitoxins to be used in the treatment of gangrenous wounds.

An antitoxin against *B. perfringens* was successfully prepared by Bull and Pritchett at the Rockefeller Institute in 1917; a less effective antiserum had previously been reported by Klose. An antitoxin against *Vibrion septique* was produced in France in 1915 by Nicolle, Cesari, and Raphael, which was feebly protective. Later in the same year more potent toxins from the latter organism were produced by Jouan and by Raphael and Frasey and more effective antitoxins were obtained. Weinberg and Séguin isolated the new species *B. oedematiens* in 1915 and later demonstrated a soluble toxin against which animals could be immunized.

The work on the production of the antitoxin for use in gas gangrene cases was begun in this country about June 1, 1918, at which time it was recommended by the board of the Central Medical Laboratory of the American Expeditionary Forces in France that the production of combined antitetanus and antigas-gangrene serum be undertaken by the manufacturing establishments in this country for use among the American troops in France.

It was the purpose in the manufacture of this serum to use horses which had previously been injected with tetanus toxin, in order that a composite serum against the most important organisms concerned in gas gangrene, as well as against the tetanus organism, might be produced as rapidly as possible.

Injections of tetanus horses with the filtrates of toxicogenic cultures of *B. perfringens* were begun at once at several of the manufacturing establishments and the first serum sent in for test was received at the Hygenic Laboratory in August of 1918.

The method of testing adopted is similar to that used in the Hygienic Laboratory method of testing tetanus and diphtheria antitoxins, with necessary modifications. Much of the basis for this work is related in the Hygienic Laboratory bulletins Nos. 21 and 43.

Toxin production by *B. perfringens* and work on the standardization of this antitoxin was first undertaken and it was proposed to follow this by investigation of the other two organisms, *Vibrion septique* and *B. oedematiens.*

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TOXIN OF B. PERFRINGENS (B. WELCHII).

The first work necessary was to obtain a toxin for use in testing the strength of the antitoxin. Advantage was taken of the published work of Bull and Prichett and DeKruif and their personal suggestions. Considerable experimentation was necessary to ascertain the best conditions for producing a good toxin. The method described in the following pages was the one used in making several of the best toxins.

Medium.—The medium used in most of the work was that used first by DeKruif, Adams, and Ireland, which was a modification of Bull's original medium. In place of the fresh pigeon muscle used by Bull, DeKruif experimented with macerated veal and found that practically as good a toxin could be obtained with this, with the additional advantage that the medium could be sterilized after the addition of the meat. The medium used at the Hygienic Laboratory consisted of beef infusion broth and chopped fresh veal in the proportion of 200 grams of the veal to 300 c. c. of the broth. Sterile glucose solution was added after sterilization in the proportion of 0.2 per cent of the total volume. The medium used in most of the work was contained in 500 c. c. Kjeldahl flasks, which on account of the small surface exposure are well adapted to the growth of anaerobic organisms.

The disadvantage of using a broth-meat medium lies in the fact that it is difficult to adjust the reaction to the desired end point, though it is probably true that the range favorable for toxin production is rather extended. Veal in the process of autoclaving produces a large amount of acid and allowance must be made for any additional heating after sterilization. Different lots of veal vary in regard to acid production, and it is difficult to control absolutely the factor of heat so that the desired final reaction may be obtained. *B. perfringens* is not as sensitive to acid as *B. diphtheriae*, however, and toxin is produced in media of much higher acidity. DeKruif recommends an initial reaction of +0.5 per cent to phenolphthalein. The end reaction favorable for the best toxin production was studied by Bull and Pritchett, who found that good toxin was produced in media, which after 24 hours incubation titrated +2 to 4 per cent acid to phenolphthalein, but when the reaction reached a point as high as +6.8 per cent the toxin was very weak.

The method used in the adjustment of the reaction in the present work when the best toxins were obtained was first to heat one flask of the batch of medium for the total length of time which was to be used for sterilization and subsequent heating, then to titrate for acid

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production and calculate the amount of alkali necessary to bring the final reaction somewhere near the desired point.

The rough preliminary adjustment of the medium was made by titration against phenolphthalein, but at various stages records were also made of the H-ion concentration as determined by the Sörensen colorimetric method. In order to obtain a medium which was favorable for good toxin production, as determined by experience, it was usually found necessary to add sufficient alkali to the medium to bring the reaction to a point represented by a *p*H value of 9 to 9.2 (which is considerably on the alkaline side of the neutral point as measured by phenolphthalein) in order to neutralize the acid produced in the process of sterilization. The purpose was to produce a medium which after the final sterilization and subsequent heating would approximate a reaction of *p*H 7.4. It was found that the individual flasks of medium varied to a considerable extent in reaction, usually ranging from *p*H 7 to 7.5. In the last lot of toxin made, which was one of the best, acidity went even higher than this, the different flasks varying from 6.7 to 6.9.

The flasks were inoculated with 10–15 c. c. of a 24-hour growth of culture. The culture had been passed through two or three pigeons before use in the inoculation of the flasks. The pigeons were usually injected in the morning with a sufficiently large amount of the culture to kill before the end of the afternoon, and the infected muscle tissue was planted into glucose broth fermentation tubes and incubated overnight. After the last pigeon passage a number of tubes to be used for planting were inoculated with the infected muscle and incubated for about 10 hours or overnight. Smears were made to determine purity of the culture, and the flasks were planted with the culture from the various tubes.

The flasks were usually heated in the Arnold sterilizer for a period of one-half hour before using and planted while still warm. Under these conditions growth was apparent within two or three hours, as evidenced by the vigorous production of gas. The incubation period was 21–24 hours.

Centrifugation was found necessary before attempting to filter if a potent toxin was desired. This was continued for three-fourths of an hour, at a speed of about 1,500 revolutions per minute.

The filtration was accomplished by means of Berkefeld N-filters. Considerable difficulty was experienced in the beginning of the work in carrying out the filtration, and apparently the strength of the various toxins obtained was in a great measure dependent on the rapidity of filtration. As a rule, when filtration was rapid a fairly good toxin was obtained, though there were exceptions to this rule.

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Some fairly potent toxins, as *Perfringens* toxins go, were obtained by the above method. The test dose for a 350-gram pigeon, as measured by the standard set by the Hygienic Laboratory, immediately after filtration was in the neighborhood of 2 c. c. and the minimum lethal dose 0.12 to 0.2 c. c. In the beginning of the work some toxins were used which had a test dose of over 3 c. c., but in the later part of the work the preliminary tests were always made with doses of 2 c. c. and 3 c. c., and toxins which did not kill on the latter test were not used further.

On the day following filtration the toxin was filled into drawn-out glass tubes which had a small surface exposure; these were sealed and stored at ice-box temperature. This method was adopted for convenience in use and also with the idea that deterioration would be less in the sealed ampoules than in a large container.

Antitoxin.—The antitoxin used in developing a standard was one furnished by the Rockefeller Institute and prepared by Maj. Bull.

STANDARDIZATION OF THE ANTITOXIN OF B. PERFRINGENS (B. WELCHII).

The Hygienic Laboratory standard was established as follows:

The unit shall be 1 c. c. of the standard serum which is kept in cold storage. To estimate the potency of a commercial antitoxin, the test toxin shall first be standardized by inoculating pigeons intramuscularly with 1/100 unit of standard serum mixed with varying amounts of toxin to determine the smallest dose of toxin which will overcome this amount of serum and kill the pigeon within 24 hours. This dose of toxin, called the "test dose," is usually somewhat greater than 10 minimal lethal doses. The test dose of toxin is then to be mixed with varying amounts of the serum to be tested and injected into a second series of pigeons; that amount of serum which gives protection for 24 hours against the test dose of toxin shall be considered to contain 1/100 unit. The serum-toxin mixtures are incubated 45 minutes at 37° C. before injection. Pigeons should weigh preferably between 325 and 375 grams, but the doses of toxin and antitoxin shall be proportioned to the weight, 350 grams being taken as the standard weight.

Provision for deterioration of serums produced by the manufacturers was made by requiring a 25 per cent excess in unitage over the number of units stated on the label.

This unit is of the same nature as the American units of tetanus and diphtheria antitoxins, that is, it is the antitoxin contained in an arbitrary amount of serum, and standardization of an unknown antitoxin is effected by comparing the respective neutralizing powers against a dose of toxin containing a number of minimal lethal doses and not against one minimal lethal dose. There was no reason to suppose that the toxin produced by *B. perfringens* differed from that of diphtheria or tetanus in the matter of containing a variable p[illegible] toxoids, or nontoxic groups, which still had the power

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of combining with antitoxin; and therefore as is true in the case of the latter antitoxins, a test of the antitoxin against the combining dose of the toxin should give a more correct test of potency of the serum than a test against one minimal lethal dose.

The neutralizing power of the Perfringens unit as established falls somewhere near that of the tetanus unit, so that the method of stating the potency of the composite serum gives a fair idea of the comparative strength of the two antitoxins. The American unit of tetanus antitoxin[1] neutralizes somewhat less than 1,000 minimal lethal doses of tetanus toxin, since the test dose of tetanus toxin is that amount which is almost neutralized by one-tenth of a unit of the standard antitoxin, and contains about 100 minimal lethal doses. In the case of Perfringens, one one-hundredth of the antitoxin unit just fails to neutralize 10 or somewhat more minimal lethal doses of Perfringens toxin, depending on the composition of the toxin; and therefore the unit neutralizes about 1,000 minimal lethal doses. However, none of the Perfringens antitoxins produced approached in neutralizing power per cubic centimeter the tetanus antitoxins. For example, in a sample containing 15 c. c. of serum there might be 1,500 units of tetanus antitoxin, or 1 unit in one one-hundredth of a c. c., while in the same sample there might be only 15 units of Perfringens toxin, or 1 unit in 1 c. c. One c. c. of the tetanus antitoxin therefore neutralizes about 100,000 minimal lethal doses of tetanus toxin and 1 c. c. of the Perfringens antitoxin neutralizes only about 1,000 minimal lethal doses of the corresponding toxin; in other words, the volume of the Perfringens antitoxin required to neutralize a certain number of minimal lethal doses is 100 times as large as the volume of tetanus antitoxin necessary to neutralize the same number of tetanus minimal lethal doses. It is thus evident that the method adopted of stating the potency gives a fair idea of the comparative strengths of the two antitoxins.

It may be remarked here that it was found very difficult for manufacturers to produce Perfringens antitoxin containing more than 1 unit per c. c., though some of the latest specimens received showed as much as 2 units per c. c.

The following protocol shows the method of testing a Perfringens antitoxin for potency.

[1] Regulations for the sale of viruses, serums, toxins, and analogous products in the District of Columbia and in Interstate Traffic, Sect. 72, Washington, 1919.

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No. of pigeon.	Weight.	Toxin.			Antitoxin.					Saline.	Hour injected.	Hour died.	Hours survived.	Necropsy.
		No.	Dose per 350 grams.	Actual dose.	No. of antitoxin.	Dose per 350 grams.	Actual dose.	Dilution.	Amount of dilution.					
	Gms.		*c.c.*	*c.c.*		*c.c.*	*c.c.*		*c.c.*	*c.c.*	*P.m.*	*A.m.*		
583	380	14B	2.6	2.82	Antitoxin X.	0.0135	0.0146	1+99	1.46	0.72	4.30		(1)	
584	370	14B	2.6	2.74	.....do.....	.012	.0127	1+99	1.27	.99	4.30		(1)	
585	360	14B	2.6	2.68	.....do.....	.012	.0123	1+99	1.23	1.09	4.30		(1)	
586	330	14B	2.6	2.45	.....do.....	.01	.0094	1+99	.94	1.61	4.30	4	11½	Typical appearance (see below).
												P.m.		
587	365	14B	2.6	2.71	Standard antitoxin.	.01	.0104	1+99	1.04	1.24	4.30	10	5½	Typical appearance.
588	330	14B	2.6	2.45	.....do.....	.01	.0094	1+99	.94	1.61	4.30	10	5½	Do.
589	320	14B	2.6	2.38	.....do.....	.01	.0091	1+99	.91	1.71	4.30	9	4½	Do.

[1] Survived.

Antitoxin X, therefore, contains 1/100 unit in slightly less than 0.012 c. c. and contains 10 units, the minimum routine human dose, in 12 c. c., with some excess.

The pigeons which do not survive usually die within the first 24 hours, and this length of time is taken as the limit for the test. A necropsy is made on all pigeons dying within this time, though the pigeons surviving are always examined for swelling and discoloration, and it is possible to judge from the extent of the lesions something as to the strength of the antitoxin. The lesions include swelling and necrosis of the muscle tissue, and hemorrhagic gelatinous exudate which is usually very abundant in the subcutaneous tissue of the groin on both the inoculated and the uninoculated sides. The exudate may be found under the breastbone also in severe cases. The internal organs show no characteristic lesions.

DETERIORATION OF TOXIN.

In the work of testing the antitoxins it was found necessary to use the toxins in the liquid form soon after they were obtained, since the time was too short to permit using a toxin which had been stored and studied first as to deterioration. In addition to the routine tests on the antitoxins, a number of tests were made as time permitted to ascertain whether the same factors influence deterioration as applied to diphtheria toxin, and thus to determine the best conditions for storing the toxin in order to keep deterioration at a minimum. In the case of diphtheria toxin, the usual procedure followed is to use a seasoned toxin; that is, one which has passed through the preliminary stages of deterioration, which may be six months or more. Rosenau [2] showed that toxin suffers a gradual loss of potency during this period and then reaches a comparatively stable condition which continues for a long period, during which time changes are very slight.

It soon became evident in the work on Perfringens toxin that this toxin has considerable stability, or at least the rate of change was gradual enough so that it could be used without fear of its suddenly losing

[2] Hygienic Laboratory Bulletin, No. 21, 1912.

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in potency. In this respect therefore it resembles diphtheria toxin more closely than tetanus toxin, which is very unstable in the liquid form.

The length of time necessary for the toxin to reach a stable condition appeared to be shorter than is the case with diphtheria toxin. In determining this change, the tests were always made against the test dose of toxin though in some cases tests of the change in minimal lethal doses were also made in order to determine the comparative loss in toxicity and in combining power.

The accompanying diagrams indicate the change taking place in several toxins during periods covering one to three months. The toxins as before stated were contained in drawn out and sealed glass tubes which left only a small amount of surface exposed. The ampoules contained between 15–20 c. c. of toxin and the temperature of storage was 5° C. It is probable that for a very accurate study of deterioration effects, storage in large containers, from which samples could have been removed under aseptic conditions from time to time, would have proved more satisfactory as the change would have been uniform throughout the whole bulk, whereas with the small containers the possibility exists that the rate of change in different ampoules may have varied owing to slight differences in conditions. Under the conditions obtaining and for the reason that it was necessary to carry out the tests on antitoxins needed for emergency military purposes before all the experimental work could be undertaken to determine these points, it was thought advisable to use small ampoules as containers for the fluid toxin and to titrate for potency at frequent intervals and just previously to testing the antitoxins which were received for tests.

Chart 1 shows the loss of combining power in toxin 14B which when first used had a test dose of somewhat less than 2.2 c. c. and in 90 days showed a test dose of less than 2.5 c. c.

The curves representing the change in the test dose and the minimal lethal dose of toxin 6 (chart 2) in a period covering 36 days shows how the test dose is a more nearly constant quantity than the minimal lethal dose, and therefore a more satisfactory measure to be used in testing the strengths of antitoxins. The rapid change in the curve rep-

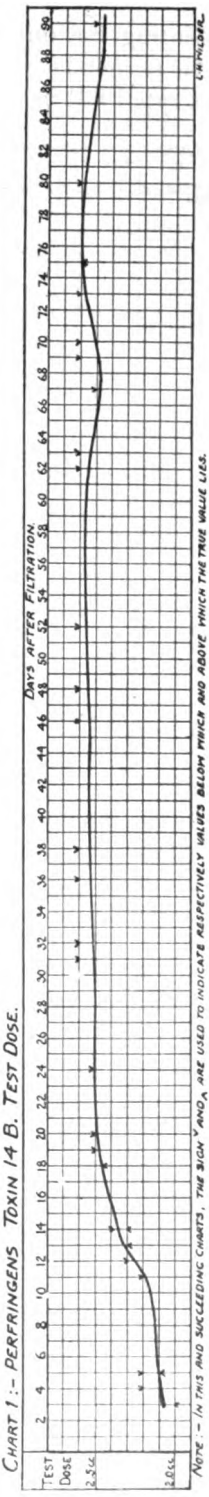

CHART 1:- PERFRINGENS TOXIN 14 B. TEST DOSE.

NOTE:- IN THIS AND SUCCEEDING CHARTS, THE SIGN ✓ AND ∧ ARE USED TO INDICATE RESPECTIVELY VALUES BELOW WHICH AND ABOVE WHICH THE TRUE VALUE LIES.

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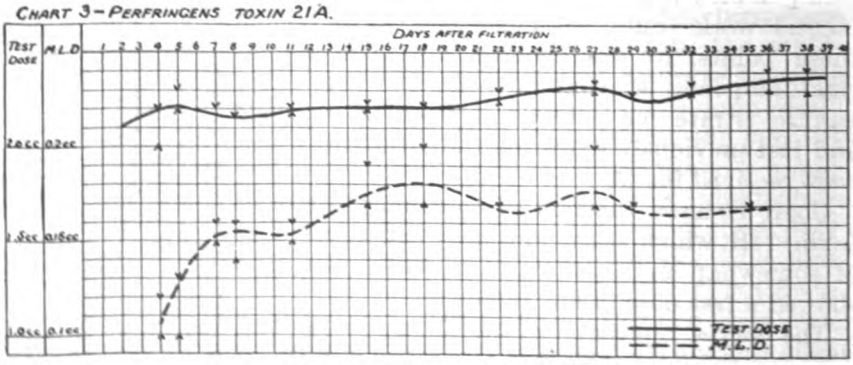
resenting the minimal lethal dose indicates a rather rapid fall in the toxic properties and the more gradual change in the test dose shows a less rapid fall in the combining power of the toxin with the antitoxin.

CHART 2 – PERFRINGENS TOXIN 6.

Chart 3 shows the results obtained in the case of toxin 21A. The curve representing the changes occurring in the minimal lethal dose show that the fluctuation of this measure would make difficult the use of the minimal lethal dose in testing the strength of the anti-

CHART 3 – PERFRINGENS TOXIN 21A.



toxi... this case the intervals between test doses were smaller a... tween tests was shorter than in the case of toxin 6, v... for a certain part of the irregularity. The curve ... test dose at corresponding intervals of time as before

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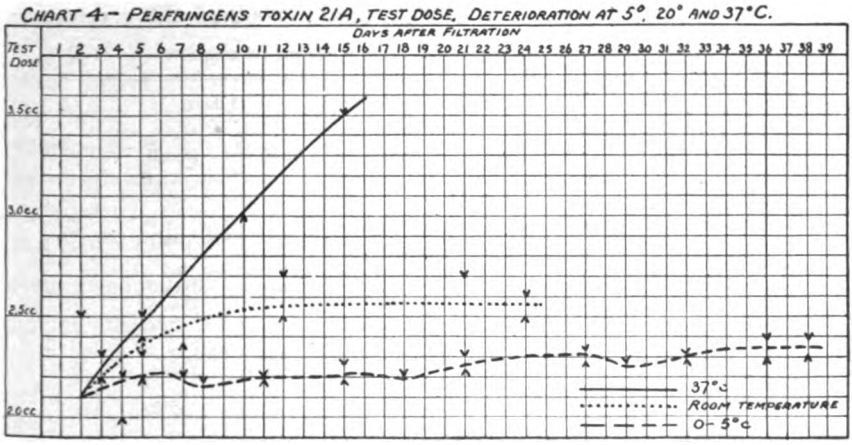
shows that the loss of combining power is proportionately less than the loss of toxic properties.

The deterioration is probably influenced by several factors, including light, temperature, reaction, oxygen tension. The effect of temperature on deterioration of the toxin is shown in the accompanying diagram (Chart 4). The test dose was determined for the three temperatures, 5° C. room temperature, and incubator temperature. The deterioration at warm-room temperature as far as tested was very rapid, as is shown by the curve rising abruptly at an angle of about 45°. At room temperature the loss was less rapid and after about 10 days the toxin apparently became quite stable. The deterioration at 5° C. was very gradual compared with that at the other two temperatures, and after 40 days the strength apparently was at

CHART 4— PERFRINGENS TOXIN 21A, TEST DOSE, DETERIORATION AT 5°, 20° AND 37°C.



about the same point as at 22 days. A low temperature is therefore indicated for storage of the toxin.

The effect of light on deterioration was tested by exposing vials of the toxin to direct sunlight. An exposure of three and one-half hours had no immediate effect on the toxin, as the pigeons inoculated with the exposed toxin died on the same dose as the control toxin. An exposure of seven hours to sunlight had the effect of increasing the test dose from 2.25 c. c. to 2.55 c. c.

The following protocol indicates this:

	Dose of toxin.	Result.
AMPOULE UNEXPOSED.	c. c.	
Pigeon 1	2.25	Died, 9 hours.
Pigeon 2	2.3	Died, 16 hours.
Pigeon 3	2.35	Died, 15 hours.
Pigeon 4	2.4	Died, 16 hours.
AMPOULE EXPOSED TO SUNLIGHT 7 HOURS.		
Pigeon 5	2.25	Survived.
Pigeon 6	2.35	Do.
Pigeon 7	2.45	Do.
Pigeon 8	2.55	Died, 9 hours.

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In these tests the control ampoules were kept at the usual temperature of storage (5° C.). Since the period of exposure to sunlight was of such short duration, it is probable that controls kept at the same temperature but not exposed to sunlight would not have shown any appreciable change.

The effect of the addition of acid and alkali as regards the keeping qualities of the toxin was tested by adding varying amounts of hydrochloric acid and sodium hydroxide to the toxin and storing at the temperature 5° C. The method used was to add measured amounts of sterile N/1 or N/10 HCl and NaOH to 10 c. c. amounts of the toxin, due allowance being made for the increase in volume in making the test. The reaction of the toxin before the addition of acid and alkali was represented by a *p*H value of 6.8. The accompanying table shows the results obtained. The test dose of the control toxin at the time these tests were made was 2.25–2.3 c. c.

Change in test dose of toxin following a change in reaction.

Amount of N/1 HCl added to 10 mil of toxin.	*p*H.	3 days.		11 days.	
		Dose.	Result.	Dose.	Result.
		c. c.		c. c.	
0.01	6.8	2.25	Survived		
		2.5	Died	2.5	Survived.
.1	6.4	2.25	Survived		
		2.5	Died		
.15	6.2	2.25	Survived	2.3	Do.
		2.5	Died	2.5	Do.
Controls		2.25	Survived	2.25	Died.
		2.25	do	2.3	Do.
		2.3	Died		

Amount of N/1 NaOH added to 10 mil of toxin.	*p*H.	3 days.		11 days.	
		Dose.	Result.	Dose.	Result.
		c. c.		c. c.	
0.01	7.0	2.25	Died	2.3	Survived.
		2.5	do	2.5	Died.
.1	7.3	2.25	do	0.15 N/1 NaOH 2.3	Survived.
		2.5	do	2.5	Do.
.2	7.5	2.25	Survived		
		2.5	do	2.5	Do.
Controls		2.25	Survived	2.25	Died.
		2.25	do	2.3	Do.
		2.3	Died		

In the case of the acid it is seen that all the pigeons on the dose 2.25 c. c. survived, while all on 2.5 c. c. died after the acid had been allowed to act three days. After 11 days the toxin had evidently deteriorated to such an extent that the pigeons survived on both doses 2.3 and 2.5 c. c.

In the case of the alkali, the addition of up to 0.1 c. c. of N/1 NaOH to 10 c. c. of toxin had no effect for three days; all of the pigeons

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inoculated with 2.25 and 2.5 c. c. died. An amount as high as 0.2 c. c. of N/1 NaOH seemed to have changed the toxin to such an extent that neither of the pigeons inoculated with 2.25 or 2.5 c. c. died. After 11 days all of the pigeons inoculated with 2.3 c. c. of the toxin survived and in two cases the pigeons on 2.5 c. c. survived. While the above experiments indicated that a considerable change in the reaction is necessary to cause marked deterioration, it is probable that the cumulative effects of small changes may be the same after longer periods of time and that therefore the reaction of the glass container may influence deterioration of the toxin.

It is thus apparent that the fluid toxin of *B. perfringens* deteriorates to a certain extent just as other fluid toxins depending on varying conditions of heat, light, reaction, and other unknown factors, but that if kept under the most favorable conditions it is reasonably stable.

A precipitated toxin was prepared early in the work and several other attempts were made to obtain a considerable amount of the dry toxin, but in all cases the yield of toxin in proportion to the volume of fluid was very small. The usual method of precipitating by saturating with ammonium sulphate crystals was the method employed. The toxin was then dried in vacuo, and stored in vacuo in a Novy jar at a temperature of 10–15° C.

Protocol indicating the results of tests made on a dry toxin against the same antitoxin at intervals of about 10 months.

	Pigeon.	Weight.	Toxin test dose.				Antitoxin.					Hours survived.
			No. of toxin.	Dose per 100 grams.	Actual dose.	Amount of dilution.	No. of antitoxin.	Dose per 100 grams.	Actual dose.	Dilution.	Amount of dilution.	
		Gms		*Gms.*	*Gms.*	*c. c.*		*c. c.*	*c. c.*		*c. c.*	
May 31, 1918..	1a	405	3	0.002	0.0081	0.24	Antitoxin 5	0.0075	0.030	1+29	0.9	Survived.
	2a	360	3	.003	.0108	.32	.....do.....	.0075	.027	1+29	.81	Do.
	3a	350	3	.005	.0175	.52	.....do.....	.0075	.026	1+29	.78	Do.
	4a	325	3	.007	.0227	.68	.....do.....	.0075	.024	1+29	.72	Do.
	5a	320	3	.010	.0320	.96	.....do.....	.0075	.024	1+29	.72	4½.
Mar. 21, 1919..	1119	355	3	.008	.0284	.85	.....do.....	.0075	.0264	1+29	.79	Survived.
	1120	340	3	.010	.034	1.02	.....do.....	.0075	.0252	1+29	.76	3.
	1121	325	3	.010	.0325	.98	.....do.....	.0075	.0242	1+29	.73	4.
	1122	320	3	.012	.0384	1.15	.....do.....	.0075	.0238	1+29	.81	4.
	1123	315	3	.012	.0378	1.03	.....do.....	.0075	.0234	1+29	.70	4.

	Pigeon.	Weight.	Minimal lethal dose.				Hours survived.
			No. of toxin.	Dose per 100 grams.	Actual dose.	Amount of dilution.	
		Grams.		*Grams.*	*Grams.*	*c. c.*	
May 31, 1918.....	11a	380	3	0.0002	0.00076	0.23	29½.
	12a	375	3	.0003	.00112	.34	13½.
	13a	340	3	.0005	.0017	.51	11½.
	14a	340	3	.0007	.0024	.72	9½.
	15a	310	3	.0010	.0031	.93	11½.
Mar. 22–23, 1919.....	1125	370	3	.0002	.00074	.22	3.
	1131	300	3	.0002	.0006	.18	Survived.
	1132	370	3	.0003	.0011	.33	17.
	1133	295	3	.0003	.00085	.255	12.

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The test dose in the first experiment against the amount of antitoxin used lies between 0.025 and 0.035 gram of the dried toxin, and in the second test between 0.028 and 0.035 gram for 350 grams weight of pigeon. The minimal lethal dose in the first test was between 0.0007 and 0.00105 gram for 350 gram or very close to the lower limit, indicated by the fact that the pigeon died after the 24 hour limit. In the second test, the minimal lethal dose was very close to 0.0007 gram since one pigeon died on this dose and another survived. These tests though limited in number indicate that the dried toxin, like tetanus toxin, is a very stable product.

TOXIN AND ANTITOXIN OF VIBRION SEPTIQUE.

The culture used by the Hygienic Laboratory in the work on the standardization of *Vibrion septique* antitoxin and which was distributed to the manufacturing concerns was one obtained from Jouan of the Pasteur Institute, and is said to correspond to Pasteur's original *Vibrion septique*.

In its cultural reactions this organism agrees with Weinberg and Séguin's description. It was found to be quite distinct as regards cultural behavior from two cultures of *B. oedematis maligni* in the collection at the Hygienic Laboratory and also distinct from *B. oedematis maligni* as described by v. Hibler. Morphologically this organism is more slender than *B. perfringens* and forms spores readily. The organism is gram-positive, is motile and somewhat pleomorphic, presenting certain peculiar forms described as citron forms which are considered characteristic of the organisms in smears from wound material. Long filamentous forms may be obtained from the liver of guinea pigs inoculated with the culture.

The organism is nonproteolytic, failing to digest casein, blood serum, or minced meat. This is in marked contrast to the behavior exhibited by the cultures of *B. oedematis maligni* which were tested in the same media. Gas was formed in glucose broth, but it is not as active in fermenting this sugar as is *B. perfringens*. The organism produces a septicemia in guinea pigs and the culture can easily be isolated from the heart blood of an animal which has been injected subcutaneously. In this respect it differs from *B. perfringens*, which can not usually be obtained from the blood but must be isolated from the muscle tissue into which the culture was inoculated.

TOXIN.

The medium recommended by Jouan and also by Raphael and Frasey, who obtained potent toxins, was Martin's peptone glucose broth [illegible] which Martin's peptone freshly made from pig's stomach su[illegible]eptic digestion is used. In this country a satisfactory t[illegible]uced by the use of a 0.2 per cent glucose veal broth

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containing 10 per cent of sterile horse serum and this medium was used in the work carried on at the Hygienic Laboratory.

Several satisfactory toxins were obtained with somewhat less difficulty than was encountered in the case of the Perfringens toxin. The toxins were tested on pigeons, rabbits, and guinea pigs and in accordance with the methods of the French investigators injections were made intravenously. De Kruif[3] recommends small guinea pigs about 200 grams weight as satisfactory test animals, the injections to be made into the jugular vein. This method was used in part of the work, but rabbits proved to be more satisfactory on account of the greater ease in making the inoculation into the ear vein, and it was found that these animals are about as susceptible as guinea pigs, weight for weight.

The animals succumb in as short a space of time as five or ten minutes if a sufficiently large dose of toxin is injected, which fact raises the question whether the substance producing the injurious effects is a true toxin. A serum which neutralizes the effects of this substance has been produced, however, and it has also been shown that a longer period intervenes before death if inoculations are made by the subcutaneous route.

ANTITOXIN.

The only sample of antitoxin against Vibrion septique which was received at the Hygienic Laboratory was one obtained from the Pasteur Institute and this was to have been used as a standard serum in testing of serums received from manufacturers.

Standardization.—The French method for testing the potency of anti-*Vibrion septique* serums was used in comparing several toxins. In accordance with the French standard, 1/1,000 c. c. of the antitoxin should neutralize two fatal doses of the toxin after 30 minutes incubation of the mixture at room temperature.

The following protocols indicate results obtained with two lots of toxin tested for the minimal lethal dose and against the Pasteur Institute antitoxin:

Toxin 2B.

	Weight.	Toxin.			Antitoxin.			Result.
		No. of toxin.	Dose per 1,000 grams.	Actual dose.	Dose per 1,000 grams.	Dilution.	Actual dose.	
	Grams.		*c. c.*	*c. c.*	*c. c.*		*c. c.*	
Rabbit 1	1,230	2B	1.0	1.23	.....	.....	.....	Died in 2 minutes.
Rabbit 2	1,220	2B	.9	1.10	.....	.....	.....	Died in 6 minutes.
Rabbit 3	1,220	2B	.8	.98	.....	.....	.....	Survived.
Rabbit 4	1,400	2B	1.8	2.52	1/1,000	1/500	[a] 0.7	Survived 6 days.

[a] The test should have been carried out according to the French standard by using 0.5 c. c. of the dilution 1/500. In this case the dose of antitoxin was inadvertently made 0.7 c. c. (i. e. 0.5 c. c. per 1,000 grams).

[3] Personal communication.

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After 8½ months storage this toxin had deteriorated to the extent that 1.5 mil per 1,000 grams failed to kill rabbits in less than five hours.

	Weight.	No. of toxin.	Dose per 1,000 grams.	Actual dose.	Length of time survived.
	Grams.		*c. c.*	*c. c.*	
Rabbit 1	1,350	2B	1.1	1.5	2 hours.
Rabbit 2	1,775	2B	1.2	2.13	4 hours.
Rabbit 3	1,650	2B	1.3	2.15	17½ hours
Rabbit 4	1,600	2B	1.4	2.24	19 hours.
Rabbit 5	1,820	2B	1.5	2.73	5 hours.

Toxin 3B (after 6 months' storage).

	Weight.	No. of Toxin.	Dose per 1,000 grams.	Actual dose.	Length of time survived.
			c. c.	*c. c.*	
Rabbit 1	1,080	3B	0.8	0.86	Survived.
Rabbit 2	1,190	3B	.9	1.07	12 hours.
Rabbit 3	1,270	3B	1.0	1.27	3 hours.
Rabbit 4	1,290	3B	1.1	1.41	5 hours.
Rabbit 5	1,340	3B	1.2	1.61	8 minutes.

	Weight.	Toxin.			Antitoxin.			Result.
		No. of toxin.	Dose per 1,000 grams.	Actual dose.	Dose per 1,000 grams.	Dilution.	Actual dose.	
			c. c.	*c. c.*	*c. c.*		*c. c.*	
Rabbit 6	1,220	3B	1.8	2.2	1/1,000	1/500	0.5	Died in 1½ hours.
Rabbit 7	1,270	3B	2.4	3.0	1/1,000	1/500	.5	Died in 9 minutes.

The amount of antitoxin used in the last test, 1/1,000 c. c., was insufficient to neutralize two fatal doses of the toxin, both twice the amount of toxin which killed in less than 10 minutes (1.2 c. c.) and twice the amount which killed in about 12 hours having been used.

B. OEDEMATIENS.

A culture received through Maj. Bull from Weinberg of the Pasteur Institute was used in several attempts to produce toxin, but no very satisfactory toxin was produced. Weinberg and Séguin state in their protocols that 1/50–1/100 c. c. of toxin inoculated subcutaneously was sufficient to kill guinea pigs in two to three days.

No toxin was obtained in our work which killed guinea pigs on a dose less than 0.25 c. c. Pigeons were not killed by 0.5 c. c. of filtrate, though 0.1–0.2 c. c. of culture killed these animals in 24 to 48 hours. A good toxin according to Weinberg and Séguin should kill guinea pigs in 1/100 c. c. doses injected intravenously and 1/400 c. c. should kill mice when injected subcutaneously.

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It is doubtful whether the culture received is identical with *B. oedematiens* described by Weinberg and Séguin. The cultural characteristics of the organism received do not correspond in all particulars with those described by the above authors. It is stated that the organism is very slightly proteolytic, not digesting blood serum, casein, or ovalbumin. The culture received by us was actively proteolytic comparing favorably in this respect with the Hygienic Laboratory cultures of *B. oedematis maligni*. Casein, blood serum, and minced meat were digested promptly. The failure to produce a potent toxin and the discrepancy as regards cultural behavior indicate that the culture probably was not identical with that used by Weinberg for best toxin production.

The author is particularly indebted to Passed Asst. Surg. J. P. Leake for suggestions and cooperation in carrying out the work.

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III. POTENCY OF BACTERIAL VACCINES SUSPENDED IN OIL (LIPO-VACCINES).

By Ida A. Bengtson, *Bacteriologist*, Hygienic Laboratory, U. S. Public Health Service.

During the course of the past year several samples of "lipo-vaccines, that is bacterial vaccines suspended in oil, made from the typhoid and paratyphoid bacilli, also from the pneumococcus, were received at the Hygienic Laboratory for testing. The use of these vaccines has been advocated on the ground that their administration is as effective as that of saline vaccines as a prophylactic measure and that the local and general reactions produced after injection are much milder so that a dose equivalent to or greater than that of the three injections of saline vaccine can be administered at one time.

The following is a preliminary report of some of the work that has been done in an effort to establish standard methods by which tests may be used to determine their efficiency.

TYPHOID-PARATYPHOID OIL VACCINES.

The Hygienic Laboratory method of testing typhoid and typhoid-paratyphoid saline vaccines consists of inoculating rabbits with the usual human doses, giving the three inoculations at intervals of four to five days.[1] In the case of typhoid vaccines the first dose is 500,000,000 and the two succeeding doses 1,000,000,000 organisms. The Hygienic Laboratory typhoid-paratyphoid vaccine contains 2,500,000,000 organisms per mil (c. c.) and the first dose consists of half a c. c. and the other two of one c. c. each. In carrying out the test the rabbits are bled about five days after the last inoculation and the serum tested for agglutinins. Complete or almost complete agglutination should occur in dilutions of about 1/400, and distinct agglutination may often occur in the 1/800 and 1/1,600 dilutions. This applies to *B. typhosus;* in the case of *B. Paratyphosus* α and *B. Paratyphosus* β agglutination occurs in lower dilutions, particularly in the case of *B. Paratyphosus* α.

The typhoid-paratyphoid oil vaccines received for test were inoculated in the usual way into rabbits, the injections being made subcutaneously on the abdomen, three rabbits being used for each test. The human dose 1 c. c. was used, and bleedings were made about ten days after the inoculations.

[1] Hygienic Laboratory Bulletin No. 110.

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The following protocols indicate some of the results obtained with the serums of the inoculated rabbits tested for the presence of agglutinins against the three organisms in the vaccines:

TYPHOID-PARATYPHOID OIL VACCINE (from Laboratory 1).

[0.3 mg. *B. Typhosus*, 0.3 mg. *B. Paratyphosus α*, 0.3 mg. *B. Paratyphosus β* per c. c.]

	Final dilutions of serum.																	
	B. typhosus Rawling.						B. paratyphosus α Mears.						B. paratyphosus β Cools.					
	1: 50.	1: 100.	1: 200.	1: 400.	1: 800.	1: 1,600.	1: 50.	1: 100.	1: 200.	1: 400.	1: 800.	1: 1,600.	1: 50.	1: 100.	1: 200.	1: 400.	1: 800.	1: 1,600.
Rabbit 1	1?	1?	1?	0	0	0	0	0	1?	0	0	0	1?	1?	1?	1?	1?	1?
Rabbit 2	1?	1?	1?	1?	1?	1?	0	0	0	0	0	0	1?	1?	1?	1?	1?	1?
Rabbit 3	1	1	1	1	1?	0	0	0	0	0	0	0	1?	1?	1?	1?	1?	1?

HYGIENIC LABORATORY TYPHOID-PARATYPHOID SALINE VACCINE 78.

Rabbit 1	3	3	3	3	2	2	3	3	3	2	1	1?	4	4	4	4	3	3
Rabbit 2	4	4	4	3	1	1?	3	2	2	1	1?	1?	4	4	4	3	3	2
Rabbit 3	4	4	4	3	1	1?	3	3	2	2	1	1	4	4	4	4	3	2
	Control (no serum) 0.						Control 0.						Control 0.					

0.3 mg. *B. Typhosus* signifies 0.3 mg. of dried typhoid organisms per c. c.

The rabbits inoculated with the typhoid-paratyphoid oil vaccine were bled again six days later and showed practically the same results in the agglutination test as those above, i. e., no definite agglutination apparent in any of the tubes.

An oil vaccine made in a second laboratory was tested and the method of injection was varied by inoculating one rabbit subcutaneously in the usual way with 1 c. c., one rabbit with 1 c. c. distributed in four different places, and a third with 2 c. c.

The following protocol shows the results obtained in the agglutination test:

TYPHOID-PARATYPHOID OIL VACCINE (from Laboratory 2.)

[2,500,000,000 each killed *B. paratyphosus α* and *β* and *B. typhosus* in each c. c.]

	Final dilutions of serum.																	
	B. typhosus Rawling.						B. paratyphosus α Mears.						B. paratyphosus β Cools.					
	1: 50.	1: 100.	1: 200.	1: 400.	1: 800.	1: 1,600.	1: 50.	1: 100.	1: 200.	1: 400.	1: 800.	1: 1,600.	1: 50.	1: 100.	1: 200.	1: 400.	1: 800.	1: 1,600.
Rabbit 1	1?	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
Rabbit 2 (4 sites)	1?	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
Rabbit 3 (2 c. c.)	1?	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1

HYGIENIC LABORATORY TYPHOID-PARATYPHOID SALINE VACCINE 94.

Rabbit 1	4	3	3	3	3	0	2	2	2	1	1	0	4	4	4	4	4	3
Rabbit 2	3	3	3	1	1?	0	2	2	1	1?	0	0	4	4	4	3	3	2
	Control (no serum) 0.						Control 0.						Control 1					

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A test was made by varying the location for injecting the oil vaccine from laboratory 1 with the following results:

1 C. C. SUBCUTANEOUSLY ON ABDOMEN.

	Final dilutions of serums.																	
	B. typhosus Rawling.						B. paratyphosus α Mears.						B. paratyphosus β Cools.					
	1: 50.	1: 100.	1: 200.	1: 400.	1: 800.	1: 1,600.	1: 50.	1: 100.	1: 200.	1: 400.	1: 800.	1: 1,600.	1: 50.	1: 100.	1: 200.	1: 400.	1: 800.	1: 1,600.
Rabbit 1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
Rabbit 2	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
Rabbit 3	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1

1 C. C. SUBCUTANEOUSLY ON THIGH.

Rabbit 1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
Rabbit 2	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
Rabbit 3	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1

1 C. C. INTRAMUSCULARLY ON THIGH.

Rabbit 1	2	1?	0	0	0	0	1?	0	0	0	0	0	4	3	2	2	1	1
Rabbit 2	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
Rabbit 3	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1

1 C. C. INTRAPERITONEALLY.

Rabbit 1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
Rabbit 2	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1

HYGIENIC LABORATORY TYPHOID-PARATYPHOID SALINE VACCINE 97 (3 INJECTIONS SUBCUTANEOUSLY).

Rabbit 1	3	3	1	0	0	0	2	2	2	1	0	0	3	3	2	2	2	1
Rabbit 2	4	4	4	3	1	0	2	2	2	2	1	0	4	4	4	3	2	2
Rabbit 3	4	4	4	3	2	0	2	2	2	1	1	0	4	4	4	3	2	2
	Control (no serum) 0.						Control 0.						Control 1.					

Only one of the rabbits receiving lipo-vaccine in the above test showed any definite agglutination. One of the three rabbits injected intramuscularly showed slight agglutination of *B. typhosus* Rawling, a suggestion of agglutination with the paratyphoid A antigen and very definite agglutination with the paratyphoid B antigen in the lower dilutions.

The above tables indicate that the oil vaccine as administered was not as effective in these tests in producing agglutinins in the animals used as were the saline vaccines. The absorption of these vaccines when injected into the loose subcutaneous tissue of the rabbit probably differs from that in the human subject. The fact that quite definite agglutination was obtained in one instance when the injection was made intramuscularly suggests that this method may be more effective than by the subcutaneous route for producing

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agglutinins, but since only one out of three rabbits showed any agglutination, it does not appear that this method can be relied on for uniform results.

PNEUMOCOCCUS OIL VACCINES.

The use of saline pneumococcus vaccine as a prophylactic measure against pneumonia was recently carried out with apparent success on an extensive scale in South Africa. This work has been reported by Lister in the Publications of the South African Institute for Medical Research, 1913–1917.[4]

Following this, prophylactic inoculation against pneumonia by the use of saline vaccines was practiced on 12,519 men of the United States Army during the year 1918, as reported by Cecil and Austin.[5] Three or four doses were administered at intervals of five to seven days, with a total of six to nine billion organisms of types I and II pneumococcus each and four and one-half to six billions of type III. During 10 weeks following the vaccinations no cases of pneumonia caused by these three types occurred among the vaccinated subjects and the incidence against pneumonias caused by type IV was much less than among unvaccinated controls.

Later in the same year pneumococcus oil vaccine was made use of as a prophylactic measure against pneumonia at Camp Wheeler, as reported by Cecil and Vaughan;[6] and 13,460 men, about 80 per cent of the camp strength, received inoculations. In this case 32 cases of pneumonia due to pneumococcus types I, II, and III occurred among the vaccinated 80 per cent, and 42 cases among the unvaccinated 20 per cent. Of the 32 cases of pneumonia due to the types I, II and III all except eight occurred within one week after vaccination and these eight were cases following severe attacks of influenza.

In our tests on the potency of pneumococcus oil vaccine, it was the purpose when the work was begun to inoculate animals or human subjects with the vaccine and after a period thought necessary for the elaboration of agglutinins and protective bodies to test the serum for the presence of these bodies in accordance with the method employed by Cecil and Austin in testing saline vaccines.

Six normal rabbits were bled from the heart and two samples of human blood were also collected. These samples were to be used later as controls in making agglutination and protection tests. Three of the above rabbits were inoculated subcutaneously on the day of bleeding with 1 c. c. each of pneumococcus oil vaccine prepared in Laboratory 1 and three with pneumococcus oil vaccine prepared in Laboratory 3. One of the human subjects was injected with 1 c. c.

[4] Lister, 1913–17. Publications of the South African Inst. for Med. Res. No. II, VII, X.
[5] Cecil and Austin, 1918. Jour. Exper. Med., vol. 28, p. 19.
[6] Cecil and Vaughan, 1919. Jour. Exper. Med., vol. 29, p. 457.

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of the first oil vaccine, and the other with 1 c. c. of the second oil vaccine. Agglutination tests of the various sera secured before inoculation were carried out with negative results throughout.

Bleedings of the rabbits and human subjects were made 14 days after inoculation. Agglutination tests were made against 24-hour-old broth cultures of type I, II, and III of pneumococcus, using highly virulent cultures of all three types. No agglutination whatever was obtained in any of the sera tested even with the undiluted serum (dilutions of serum 1:1 to 1:40 were used). A control set of tubes with pneumococcus immune diagnostic serum of each type was run in each case with the following results:

	Dilutions of serum.					
	1:1	1:2	1:5	1:10	1:20	1:40
Type I	4	4	4	4	4	4
Type II	4	4	4	3	3	3
Type III	3	3	3	2	1	0

This showed that the cultures used were readily agglutinable.

Protection tests on mice were carried out with the rabbit sera against broth cultures of the three types of pneumococcus. An equal number of control mice were injected with normal sera of the corresponding rabbits; 0.2 c. c. of serum was injected into each mouse.

The following is a summary of the results obtained:

	Number of mice inoculated.	Number of mice died.
Type I: 0.0001 c.c. to 0.000001 c.c. (test mice)	24	24
Type I: 0.00001 c.c. to 0.0000001 c.c. (control mice with normal serum)	24	24
Type II: 0.00001 c.c. to 0.0000001 c.c. (test mice)	24	13
Type II: 0.00001 c.c. to 0.0000001 c.c. (control mice with normal serum)	24	15
Type III: 0.0001 c.c. to 0.000001 c.c. (test mice)	24	20
Type III: 0.0001 c.c. to 0.000001 c.c. (control mice with normal serum)	24	21

The results in this test show practically no difference in the amount of protection afforded by the sera from vaccinated rabbits and those from unvaccinated rabbits except that in the case of the serum of one rabbit, which had been inoculated with the second oil vaccine, only one mouse out of the six test mice inoculated with type II culture died and four out of the six controls died.

The four surviving rabbits used in the above tests were bled a second time one month after vaccination. Agglutination tests were again entirely negative. Protection tests were made on mice, using cultures of the three different pneumococcus types, all three of which were fatal in doses of 0.0000001 c. c. to 0.00000001 c. c. (in each case both control mice without serum inoculated with 0.0000001 c. c. died,

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and one of the two mice inoculated with 0.00000001 c. c. died). The control mice were inoculated with cultures alone. The following summarizes the results obtained:

Type I: All mice died (test mice and control mice).

Type II: The serum from three of the rabbits showed no protection whatever, but in the fourth case all the mice survived, showing there was some protective property in the serum from this rabbit. Somewhat similar results were obtained in the previous test, from this same rabbit when bleedings were made 14 days after inoculations.

Type III: No protection was shown with the serum of any of the rabbits.

Tests were carried out with the sera from the two vaccinated human subjects A (Laboratory 3) and B (Laboratory 1).

SERUM A.

	Number of mice inoculated.	Number of mice died.
Type I: 0.0000001 to 0.00000001 c. c. (mice treated with immune serum)	4	[1] 3
Type I: 0.0000001 to 0.00000001 c. c. (mice treated with normal serum)	4	4
Type I: 0.0000001 to 0.00000001 c. c. (mice receiving no serum)	4	3
Type II: 0.0000001 to 0.00000001 c. c. (mice treated with immune serum)	4	[2] 2
Type II: 0.0000001 to 0.00000001 c. c. (mice treated with normal serum)	4	1
Type II: 0.0000001 to 0.00000001 c. c. (mice receiving no serum)	4	4
Type III: 0.0000001 to 0.00000001 c. c. (mice treated with immune serum	4	0
Type III: 0.0000001 to 0.00000001 c. c. (mice treated with normal serum)	4	3
Type III: 0.0000001 to 0.00000001 c. c. (mice receiving no serum)	4	4

SERUM B.

Type I: 0.0000001 to 0.00000001 c. c. (mice treated with immune serum)	4	3
Type I: 0.0000001 to 0.00000001 c. c. (mice treated with normal serum)	4	4
Type I: 0.0000001 to 0.00000001 c. c. (mice receiving no serum)	4	3
Type II: 0.0000001 to 0.00000001 c. c. (mice treated with immune serum)	4	[1] 1
Type II: 0.0000001 to 0.00000001 c. c. (mice treated with normal serum)	4	0
Type II: 0.0000001 to 0.00000001 c. c. (mice receiving no serum)	4	4
Type III: 0.0000001 to 0.00000001 c. c. (mice treated with immune serum)	4	1
Type III: 0.0000001 to 0.00000001 c. c. (mice treated with normal serum)	4	2
Type III: 0.0000001 to 0.00000001 c. c. (mice receiving no serum)	4	4

[1] Mouse-typhoid infection. [2] 2 Mouse-typhoid infection.

The 12 vaccinated mice treated with human immune serum A showed a probable protection against the types II and III and possible protection against type I. Two of the 12 mice died of undoubted pneumococcus infection and 7 survived (3 mice died of mouse-typhoid infection). Of the 12 vaccinated mice treated with human immune serum B, 4 died of pneumococcus infection (1 of mouse-typhoid infection). A certain amount of protection was apparently afforded by normal serum. Normal serum B, as well as normal serum A, showed rather marked protection against type II, and both showed slight protection against type III. The 12 control mice which received cultures without any serum all died, with one exception (type I, 0.00000001 c. c.).

Tests were carried out by inoculating mice directly with the oil vac[illegible]m laboratory 1, using 1 c.c. of the vaccine injected subcu- t[illegible] Twenty-four vaccinated mice were inoculated with cul-

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tures 14 days later. Dilutions of 0.0000001 and 0.00000001 of 24-hour broth cultures of each of these three different types of pneumococcus were used.

	Test mice.		Control mice.	
	Number inoculated.	Number died.	Number inoculated.	Number died.
Type I:				
0.0000001 c. c.	4	1	4	4
0.00000001 c. c.	4	[1] 1	4	3
Type II:				
0.0000001 c. c.	4	[2] 1	4	4
0.00000001 c. c.	4	[2] 1	4	2
Type III:				
0.0000001 c. c.	4	[4] 3	4	2
0.00000001 c. c.	4	[3] 1	4	1

[1] Vaccine not absorbed; mouse-typhoid infection.
[2] Mouse-typhoid infection.
[3] Vaccine not absorbed.
[4] 2 mouse-typhoid infection.

The results show quite definite protection against types I and II.

A further test was carried out on mice with some variations from the methods used above. A number of mice were injected with the pneumococcus oil vaccine from Laboratory 1, in this case using 0.5 c. c. of vaccine instead of 1 c. c. and part of the mice being injected intraperitoneally instead of subcutaneously.

Fourteen days later 36 of the mice vaccinated subcutaneously were inoculated intraperitoneally with 24-hour broth cultures of the three types of pneumococcus, with the following results:

	Test mice.		Control mice.	
	Number injected.	Number died.	Number injected.	Number died.
Type I:				
0.0000001 c. c.	6	5	6	6
0.00000001 c. c.	6	3	6	6
Type II:				
0.0000001 c. c.	6	5	6	6
0.00000001 c. c.	6	6	6	6
Type III:				
0.0000001 c. c.	6	6	6	6
0.00000001 c. c.	6	6	6	6

The test though not as satisfactory as the previous one indicates some protection of the vaccine against type I.

Nine mice vaccinated intraperitoneally were also inoculated with cultures, 0.0000001 c. c. of each type being used throughout. The following indicates the results obtained:

	Test mice.		Control mice.	
	Number injected.	Number died.	Number injected.	Number died.
Type I: [illegible] c. c.	5	2	6	6
Type II: [illegible] c. c.	5	4	6	6
Type III: [illegible] c. c.	5	4	6	6

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Rather definite protection against type I is shown in this test and slight protection against types II and III.

Several direct protection tests were carried out on rabbits. In testing the action of pneumococcus vaccine on rabbits it was necessary to determine the virulence of the cultures for this species. Type I was found to be fatal to these animals in the same quantities as to mice, viz, 0.0000001 to 0.00000001 c. c. of culture inoculated intraperitoneally. Rabbits receiving these doses invariably succumbed within 48 hours to a pneumococcus septicemia. Irregular results were obtained with types II and III, indicating that in the case of these two types maintenance of virulence by passage through mice does not necessarily afford a corresponding degree of maintenance of virulence for rabbits. This was particularly true of type III, which sometimes failed to kill in a dilution of 0.01 c. c.

Several rabbits were injected subcutaneously with 1 c. c. of oil vaccine; 14 days later two of the rabbits were injected intraperitoneally with broth cultures of the type I of pneumococcus and two normal rabbits were injected with corresponding amount of culture. The following shows the results obtained:

Test rabbits:
  Type I, 0.00000001 c. c:
    Rabbit 1 survived.
    Rabbit 2 survived.
Control rabbits (culture alone, 0.0000000 1 c. c.):
  Rabbit 3, died in 42 hours.
  Rabbit 4, died in 42 hours.

A test was carried out on mice to determine the relative protection afforded by saline and oil vaccines. Equal numbers of mice were inoculated with saline and oil vaccines, one-half of each group being inoculated with 0.5 c. c. of vaccine and the remaining half with 0.25 c. c. The saline vaccine contained 1,000,000,000 organisms each of types I, II, and III and the oil vaccine 0.7 mg. each of types I, II, and III per c. c.

Eleven days after vaccination the mice were inoculated intraperitoneally with 24-hour broth cultures of the three types of pneumococcus in dilutions of 0.0000001 to 0.00000001. The following summarizes the results obtained. A corresponding number of control mice were inoculated with culture alone at the same time as the vaccinated mice were inoculated with cultures.

OIL VACCINE.

	Number of mice inoculated.	Number of mice survived.	Number of mice died.
Type I: 0.0000001 to 0.00000001 c. c.	8	4	14
Type II [illegible] to 0.00000001 c. c.	8	2	16
Type [illegible] to 0.00000001 c. c.	8	1	17
	24	7	17

[illegible]oil.

[illegible]s and mouse-typhoid infection; 1 mouse-typhoid infection.

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SALINE VACCINE.

	Number of mice inoculated.	Number of mice survived.	Number of mice dead.
Type I: 0.0000001 to 0.00000001 c. c.	8	4	[2] 4
Type II: 0.0000001 to 0.00000001 c. c.	9	5	[1] 4
Type III: 0.0000001 to 0.00000001 c. c.	7	5	[1] 2
	24	14	10

CONTROL MICE INOCULATED WITH CULTURES ALONE.

Type I: 0.0000001 to 0.00000001 c. c.	8	0	8
Type II: 0.0000001 to 0.00000001 c. c.	8	0	[1] 8
Type III: 0.0000001 to 0.00000001 c. c.	8	1	[1] 7
	24	1	23

[1] 1 mouse-typhoid infection.
[2] 2 mouse-typhoid infection; 1 mixture pneumococcus and mouse-typhoid infection; 1 no growth on plate.

Summary.

Oil vaccine:
24 mice inoculated.
7 survived.
12 died (pneumococcus infection).
5 negative or doubtful.
Saline vaccine:
24 mice inoculated.
14 survived.
4 died (pneumococcus infection).
6 negative or doubtful.

The results in this test indicate that the saline vaccine was approximately twice as effective as the oil vaccine. Some protection was definitely afforded by each vaccine, since all the control mice on culture alone died except one (0.00000001 c. c. of type III).

A test was carried out with the pneumococcus oil vaccine from Laboratory 1, Hygienic Laboratory pneumococcus saline vaccine, and a commercial pneumococcus saline vaccine. These contained types I, II, and III of pneumococcus as follows:

Oil vaccine Laboratory 1 0.83 mg. of each type per c. c.
Hygienic Laboratory saline vaccine, 1,000,000,000 each of types I, II, and III per c. c.
Commercial saline vaccine 3,000,000,000 each of types I, II, and III per c. c.

Three series of mice were inoculated subcutaneously with 0.5 c. c. of the respective vaccines; 14 days later the surviving mice received cultures intraperitoneally.

OIL VACCINE, LABORATORY 1.

	Number of mice inoculated.	Number of mice survived.	Number of mice died.
Type I: 0.0000001 c. c.	5	1	4
Type I: 0.00000001 c. c.	5	3	[1] 2
Type II: 0.0000001 c. c.	5	0	[1] 5
Type II: 0.00000001 c. c.	5	0	5
Type III: 0.0000001 c. c.	5	0	5
Type III: 0.00000001 c. c.	5	2	[2] 3
	30	6	24

[1] Doubtful pneumococcus infection. [2] 1 doubtful, 1 not pneumococcus infection.

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HYGIENIC LABORATORY SALINE VACCINE.

	Number of mice inoculated.	Number of mice survived.	Number of mice died.
Type I: 0.0000001 c. c	4	3	1
Type I: 0.00000001 c. c	4	3	[1] 1
Type II: 0.0000001 c. c	4	2	2
Type II: 0.00000001 c. c	4	1	3
Type III: 0.0000001 c. c	4	3	1
Type III: 0.00000001 c. c	4	1	3
	24	13	11

COMMERCIAL SALINE VACCINE.

Type I: 0.0000001 c. c	3	2	1
Type I: 0.00000001 c. c	3	1	2
Type II: 0.0000001 c. c	3	3	0
Type II: 0.00000001 c. c	3	2	1
Type III: 0.0000001 c. c	3	0	3
Type III: 0.00000001 c. c	3	2	1
	18	10	8

CONTROL MICE INOCULATED WITH CULTURES ALONE.

Type I: 0.0000001 c. c	5	0	5
Type I: 0.00000001 c. c	5	0	5
Type II: 0.000000 c. c	5	0	5
Type II: 0.00000001 c. c	5	0	5
Type III: 0.0000001 c. c	5	0	5
Type III: 0.00000001 c. c	5	3	2
	30	3	27

[1] Doubtful pneumococcus infection.

Protection was afforded against the cultures for slightly more than half of the mice treated with saline vaccine, and for less than one-third of the mice inoculated with the oil vaccine.

CONCLUSIONS.

Tests have been carried out with certain oil vaccines for the purpose of establishing methods of standardizing the potency testing of these products. The preliminary work is here reported, but as yet not sufficient data have been obtained to justify the establishment of any definite standard or method of testing.

In the case of the typhoid-paratyphoid oil vaccines the adaptation of the Hygienic Laboratory method of testing saline vaccines on rabbits for the production of agglutinins did not give results which compared favorably with those of saline vaccines, as far as carried out.

Pneumococcus oil and saline vaccines were tested on mice and rabbits. A few tests with the oil vaccine on human subjects were also made. The results obtained in the case of rabbits and mice indicate that though both afford a certain amount of protection, the saline vaccine was rather more effective in these animals. Protection tests made with immune sera from human subjects showed somewhat more favorable results than corresponding tests carried out with immune sera from rabbits, though testing on human subjects is always a practical method for testing products.

These tests which were performed solely as a study in st[illegible] could not be interpreted as having any necessary bear[illegible] in[illegible]actic use of oil vaccines to prevent infection in man.

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HYGIENIC LABORATORY BULLETINS OF THE PUBLIC HEALTH SERVICE.

The Hygienic Laboratory was established in New York, at the Marine Hospital on Staten Island, August, 1887. It was transferred to Washington, with quarters in the Butler Building, June 11, 1891, and a new laboratory building, located in Washington, was authorized by act of Congress March 3, 1901.

Of the bulletins published by the laboratory since its establishment, copies of the following are available for distribution and may be obtained without cost by applying to the Surgeon General, United States Public Health Service, Washington, D. C.:

No. 2.—Formalin disinfection of baggage without apparatus. By M. J. Rosenau.

No. 43.—The standardization of tetanus antitoxin (an American unit established under authority of the act of July 1, 1902). By M. J. Rosenau and John F. Anderson.

No. 46.—*Hepatozoon perniciosum* (n. g., n. sp.); a hæmogregarine pathogenic for white rats; with a description of the sexual cycle in the intermediate host, a mite (*Ielaps echidnimus*). By W. W. Miller.

No. 50.—Further studies upon the phenomenon of anaphylaxis. By M. J. Rosenau and John F. Anderson.

No. 51.—Chemical tests for blood. By Joseph H. Kastle.

No. 52.—Report No. 3 on the origin and prevalence of typhoid fever in the District of Columbia (1908). By M. J. Rosenau, Leslie L. Lumsden, and Joseph H. Kastle.

No. 55.—Quantitative pharmacological studies; adrenalin and adrenalin-like bodies. By W. H. Schultz.

No. 59.—The oxidases and other oxygen catalysts concerned in biological oxidations. By Joseph Hoehing Kastle.

No. 65.—Facts and problems of rabies. By A. M. Stimson.

No. 73.—The effect of a number of derivatives of choline and analogous compounds on the blood pressure. By Reid Hunt and R. de M. Taveau.

No. 75.—Digest of comments on the Pharmacopœia of the United States of America (eighth decennial revision) and the National Formulary (third edition) for the calendar year ending December 31, 1908. By Murray Galt Motter and Martin I. Wilbert.

No. 76.—The physiological standardization of ergot. By Charles Wallis Edmunds and Worth Hale.

No. 78.—Report No. 4 on the origin and prevalence of typhoid fever in the District of Columbia (1909). By L. L. Lumsden and John F. Anderson. (Including articles contributed by Thomas B. McClintic and Wade H. Frost.)

No. 81.—Tissue proliferation in plasma medium. By John Sundwall.

No. 86.—Studies on typhus. By John F. Anderson and Joseph Goldberger.

No. 87.—Digest of comments on the Pharmacopœia of the United States of America (eighth decennial revision) and on the National Formulary (third edition) for the calendar year ending December 31, 1911. By Murray Galt Motter and Martin I. Wilbert.

No. 89.—Sewage pollution of interstate and international waters with special reference to the spread of typhoid fever. VI. The Missouri River from Sioux City to its mouth. By Allan J. McLaughlin.

No. 91.—I. The cause of death from subdural injections of antimeningitis serum. By Worth Hale. II. Some new cholera selective media. By Joseph Goldberger.

No. 94.—I. Collected studies on the insect transmission of *Trypanosoma evansi*. By M. Bruin Mitzmain. II. Summary of experiments in the transmission of anthrax by biting flies. By M. Bruin Mitzmain.

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No. 95.—Laboratory studies on tetanus. By Edward Francis.

No. 96.—1. Report of investigation of coastal waters in the vicinity of Gulfport and Biloxi, Miss., with special reference to the pollution of shellfish. By R. H. Creel. 2. A comparison of methods for the determination of oxygen in waters in presence of nitrite. By Elias Elvove. 3. Some new compounds of the choline type. III. Including preparation of monoacetate of *a*, *B* dioxy-*B*-methyl butane. By G. A. Menge. 4. The detection of white phosphorus in matches. By Earle B. Phelps. 5. The chemical composition of rubber in nursing nipples and in some rubber toys. By Earle B. Phelps and Albert F. Stevenson. 6. The analysis of thymol capsules. By Atherton Seidell. 7. Seasonal variation in the composition of the thyroid gland. By Atherton Seidell and Frederic Fenger. 8. Note on a new apparatus for use with the Winkler method for dissolved oxygen in water. By Hyman L. Shoub. 9. The pharmacological action of some serum preservatives. By Carl Voegtlin.

No. 97.—1. Some further siphonaptera. 2. A further report on the identification of some siphonaptera from the Philippine Islands. 3. The taxonomic value of the copulatory organs of the females in the order of siphonaptera. By Carroll Fox.

No. 100.—1. Pituitary standardization; a comparison of the physiological activity of some commercial pituitary preparations. By George B. Roth. 2. Examination of drinking water on railroad trains. By Richard H. Creel. 3. Variation in the epinephrine content of suprarenal glands. By Atherton Seidell and Frederic Fenger.

No. 102.—I. Digitalis standardization. The physiological valuation of fat-free digitalis and commercial digitalin. By George B. Roth. II. Preliminary observations on metabolism in pellagra. By Andrew Hunter, Maurice H. Givens, and Robert C. Lewis.

No. 103.—I. Chemical changes in the central nervous system as a result of restricted vegetable diet. By Mathilde L. Koch and Carl Voegtlin. II. Chemical changes in the central nervous system in pellagra. By Mathilde L. Koch and Carl Voegtlin.

No. 104.—Investigation of the pollution and sanitary conditions of the Potomac watershed; with special reference to self-purification and sanitary condition of shellfish in the lower Potomac River. By Hugh S. Cumming. With plankton studies by W. C. Purdy and hydrographic studies by Homer P. Ritter.

No. 106.—Studies in Pellagra. I. Tissue alteration in malnutrition and pellagra. By John Sundwall. II. Cultivation experiments with the blood and spinal fluid of pellagrins. By Edward Francis. III. Further attempts to transmit pellagra to monkeys. By Edward Francis.

No. 108.—Experimental studies with muscicides and other fly-destroying agencies. By Earle B. Phelps and A. F. Stevenson.

No. 109.—I. Pituitary standardization, 2: The relative value of infundibular extracts made from different species of mammals and a comparison of their physiological activity with that of certain commercial preparations. By George B. Roth. II. Pharmacological studies with cocaine and novocaine; a comparative investigation of these substances in intact animals and on isolated organs. By George B. Roth.

No. 110.—I. The standarization of antityphoid vaccine. By George W. McCoy. II. A colorimetric method for the estimation of the cresol or phenol preservative in serums. By Elias Elvove. II. Toxicity of certain preservatives used in serums, viruses, and vaccines. By James P. Leake and Hugh B. Corbitt. IV. Observations on the significance of antisheep amboceptor in human serum, with reference to complement fixation test for syphilis. By Mather H. Neill.

No. 111.—I. The pathology and pathogenesis of myelitis. By N. E. Wayson. II. Experimental poliomyelitis. By J. P. Leake. III. Attempts to induce poliomyelitis in small laboratory animals. By A. M. Stimson. IV. Report on attempts to cultivate the virus of poliomyelitis. By N. E. Wayson.

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No. 112.—I. Phenols as preservatives of antipneumococcic serum; a pharmacological study. By Carl Voegtlin. II. The nature of contaminations of biological products. By I. A. Bengtson. IV. Studies in preservatives of biological products: The effects of certain substances on organisms found in biological products. By M. H. Neill. IV. The effect of ether on tetanus spores and on certain other microorganisms. By H. B. Corbitt.

No. 113.—I. An experimental investigation of the toxicity of certain organic arsenic compounds. By George B. Roth. II. On the toxicity of emetine hydrochloride, with special reference to the comparative toxicity of various market preparations. By Gleason C. Lake.

No. 114.—Index catalogue of medical and veterinary zoology. Subject: Roundworms. By Ch. Wardell Stiles and Albert Hassall. In press.

No. 115.—I. Notes on the detection of *B. tetani*. By G. W. McCoy and Ida A. Bengtson. II. The standardization of pituitary extracts. By Reynold A. Spaeth.

No. 116.—I. The influence of vitamines on the course of pellagra. By Carl Voegtlin, M. H. Neill, and Andrew Hunter. II. The chemical composition of the blood of pellagrins. By Robert C. Lewis. III. The amino acid fractions and hippuric acid in the urine of pellagrins. By John R. Murlin. IV. The occurrence of pellagra in nursing infants, with observations on the chemical composition of the human milk from pellagrous mothers. By Carl Voegtlin and R. H. Harries.

No. 117.—Filariasis in southern United States. By Edward Francis.

No. 118.—Digest of comments on the Pharmacopœia of the United States of America and on the National Formulary for the calendar year ending December 31, 1915. By A. G. Du Mez.

No. 119.—Digest of comments on the Pharmacopœia of the United States of America and on the National Formulary for the calendar year ending December 31, 1916. By A. G. Du Mez.

No. 120.—I. The experimental production of pellagra in human subjects by means of diet. By Joseph Goldberger and G. A. Wheeler. II. The pellagra-producing diet. By M. X. Sullivan and K. K. Jones. III. Biological study of a diet resembling the Rankin Farm diet. By M. X. Sullivan. IV. Feeding experiments with the Rankin Farm pellagra-producing diet. By M. X. Sullivan.

No. 121.—The generic names of bacteria. By Ella M. A. Enlows.

No. 122.—I. Deterioration of typhoid vaccine. By G. W. McCoy and Ida A. Bengtson. II. Standardization of gas gangrene antitoxin. By Ida A. Bengtson. III. Potency of bacterial vaccines suspended in oil (lipovaccines). By Ida A. Bengtson.

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TREASURY DEPARTMENT
UNITED STATES PUBLIC HEALTH SERVICE

HYGIENIC LABORATORY—BULLETIN No. 123
FEBRUARY, 1921

I. EXPERIMENTS UPON VOLUNTEERS TO DETERMINE THE CAUSE AND MODE OF SPREAD OF INFLUENZA, BOSTON, NOVEMBER AND DECEMBER, 1918

By M. J. ROSENAU, W. J. KEEGAN, JOSEPH GOLDBERGER, and G. C. LAKE

II. EXPERIMENTS UPON VOLUNTEERS TO DETERMINE THE CAUSE AND MODE OF SPREAD OF INFLUENZA, SAN FRANCISCO, NOVEMBER AND DECEMBER, 1918

By G. W. McCOY and DE WAYNE RICHEY

III. EXPERIMENTS UPON VOLUNTEERS TO DETERMINE THE CAUSE AND MODE OF SPREAD OF INFLUENZA, BOSTON, FEBRUARY AND MARCH, 1919

By M. J. ROSENAU, W. J. KEEGAN, DE WAYNE RICHEY, G. W. McCOY, JOSEPH GOLDBERGER, J. P. LEAKE, and G. C. LAKE

WASHINGTON
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United States Public Health Service.

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CONTENTS.

	Page.
I. Series of experiments at Boston, November and December, 1918, by M. J. Rosenau, W. J. Keegan, Joseph Goldberger, and G. C. Lake	5
Introduction and acknowledgments	5
Subjects of experiments	7
Description of experiments	12
Summary and discussion of results	20
Appendices	22
A. Donors	22
B. History of cultures of Pfeiffer's bacillus used	28
C. Account of the outbreak on the U. S. S. Yacona	30
II. Series of experiments at San Francisco, November and December, 1918, by G. W. McCoy and De Wayne Richey	42
Introduction	42
Subjects for experimentation	43
Description of experiments	44
Summary	50
Tables	51
III. Series of experiments at Boston, February and March, 1919, by M. J. Rosenau, W. J. Keegan, De Wayne Richey, G. W. McCoy, Joseph Goldberger, J. P. Leake, and G. C. Lake	54
General considerations	54
Volunteers	55
Experiments	59
Summary	90
Conclusions	96

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I. SERIES OF EXPERIMENTS AT BOSTON, NOVEMBER AND DECEMBER, 1918.[1]

By Lieut. Commander M. J. Rosenau and Lieut. W. J. Keegan, United States Navy, and Surg. Joseph Goldberger and Passed Asst. Surg. G. C. Lake, United States Public Health Service.

INTRODUCTION AND ACKNOWLEDGMENTS.

These experiments were carried on jointly by medical officers who were detailed for this purpose from the United States Navy and the United States Public Health Service, at the United States Quarantine Station, Gallups Island, and the United States Naval Hospital, Chelsea, Mass. The experiments were started November 6, and unavoidably discontinued December 23, 1918.

We desire especially to acknowledge the hearty cooperation accorded us by Surg. Gen. W. C. Braisted, United States Navy, and Surg. Gen. Rupert Blue, United States Public Health Service, and the sympathetic understanding of the officers in these bureaus, particularly Lieut. Commander J. R. Phelps, of the Bureau of Medicine and Surgery, United States Navy, and Assistant Surgeon Generals J. W. Schereschewsky and R. H. Creel, United States Public Health Service. We are furthermore particularly indebted to the late Surgeon Donald Currie, United States Public Health Service, in command of the United States Quarantine Station on Gallups Island, for many courtesies and facilities. Toward the close of the study, Dr. Currie contracted influenza, complicated with pneumonia, and died. His assistants, Acting Assistant Surgeons F. X. Crawford and E. M. Looney, helped the work in many direct and practical ways. We are under special obligations to Capt. John M. Edgar, district medical aide, United States Navy, and his able associate, Surgeon W. M. Bryan, United States Public Health Service, sanitary inspector of the first naval district, for practical assistance, which made it possible to carry on many details of the experiments. It is a pleasure also to acknowledge the cooperation we had from Capt. N. S. Blackwood, Medical Corps, United States Navy, in command of the naval hospital at Chelsea, and to his efficient executive surgeon, Commander J. M. Brister, Medical Corps, United States Navy. We were freely given the time and experience of Lieut. Commander L. W. McGuire, Medical Corps,

[1]Submitted for publication May, 1919.

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United States Navy, and Lieut. W. R. Redden, Medical Corps, United States Navy, in helping us select donors and in acting as consultants in the case of one of the volunteers who was taken ill at Gallups Island. Acting Assistant Surgeon C. J. Longstreet, United States Public Health Service, helped in supervising the separation of the experimental groups.

A word of appreciation is due to the men who subjected themselves to experimentation; they were warned of the danger and believed, as did those who conducted the study, that they were risking their lives. The fact that none was harmed does not detract from the fine spirit, splendid courage, and readiness to serve humanity displayed by all of them.

Following is the list of names of those who volunteered to take influenza for the purposes of these experiments:

Abney, Dewey Lavern.
Allan, Robert Andrew.
Anderson, Arthur Raymond.
Bolduc, Joseph Real.
Bullock, Muro Chester.
Calabrese, James Joseph.
Center, Edward Thomas.
Colton, Charles.
Conroy, H. A.
Crist, Bertram.
Crowley, Henry Edward.
Denaard, Arthur Frederick.
Edman, Charles Frederick.
Englert, Henry Joseph.
Felton, James Elwyn.
Fleming, George William.
Foster, John.
Fournier, Ernest Joseph.
Garriott, Simon George.
Gerow, Percy Hector.
Gibson, Edward Molten.
Goodwin, R. E.
Healy, Thomas B.
Hedges, Daniel Judd.
Kearney, Engene Aloysius.
Klient, Thomas.
Malone, Walter James.
Marcum, Charles.
Maas, Paul Alfred.
Morrell, William Francis.
Murphy, Leonard Richard.
Murphy, William Joseph.
Mc A[illegible] John Henry.
M[illegible]h Edward.
Nerling, Gustave.
Ortiz, Julius.
O'Toole, Frank Codman.
Peak, George Francis.
Pruett, George.
Reid, Robert Lincoln.
Scott, Robert James.
Slipp, Clarence.
Stanton, Judson Horatio.
Vandermeer, John William.
Vanelli, Arthur Nicholas.
Veteto, Gus Robert.
Vieira, Leopold Joseph.
Wanless, Frank B.
Heine, John Joseph.
Hill, Warren Arthur.
Holmes, Harrison Stephen.
Aimar, Bertram Hillard.
Crews, Millard.
Dawson, Harvey Allen.
Fink, Herbert Jacob.
O'Neill, Nick Persian.
Evans, Hugh John.
Holziner, Carl Peter.
Warren, Robert Flagg.
Whipp, Raymond Calvin.
Walker, E. F.
Hickey, Edward John.
Jones, Orlando Lloyd.
Lang, William Norman.
Myers, Fred.
Balbian, Frederick.
Campbell, Verlin Everett.
Micks, Albert.

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SUBJECTS OF EXPERIMENT.

The men subjected to these experiments were all volunteers from the United States Naval Training Station, Deer Island, Boston. They numbered 62 in all, and varied in age from 15 to 34 years, 54 of them being 18 to 21 years of age. Aside from the fact that several had more or less enlarged tonsils, all appeared to be in excellent physical condition.

An epidemic of influenza had prevailed at the Deer Island Station, 186 cases having been recorded between September 7 and November 3, 1918, in an average population of 1,058 men (an incidence rate of 176 per 1,000), so that in varying degree all of these men had been exposed to the infection at this station, and in some instances also at preceding stations and places.

From a study of the individual official health records, and from histories elicited by questioning each volunteer, it would appear that 12 of them had an attack of influenza during the recent epidemic, 2 gave a history of illness which was probably this disease, 1 a doubtful history, and 47 appear to have escaped an attack during the epidemic. Of the latter 47, 3 gave histories of influenza-like attacks previous to the present epidemic, 2 of attacks that may be classified as probably influenza, and 3 of attacks of a suggestive but doubtful character. Of our 62 subjects, therefore, 39 were without history of an attack of influenza at any time, 15 with a history of this disease, and 8 with a history of attacks which may or may not have been influenza.

A list of the volunteer subjects with summary of pertinent data is presented in Table I.

TABLE 1.—*List of volunteers, Boston experiments, November and December 1918.*

No.	Age.	Possible exposure to influenza during present epidemic, 1918.		History of attack of influenza or "grippe."		Remarks.
		On Deer Island since—	Previous to arrival at Deer Island.	Epidemic, 1918.	Previous to epidemic, 1918.	
1	19	Sept. 15	No.....	Yes, Sept. 23..	No.....	
2	18	Sept. 29	No.....	No.....	No.....	
3	20	Sept. 24	Yes.....	No.....	Doubtful, 1916 and 1917.	On Sept. 7 and Sept. 8 slept with a comrade who was coming down with an attack.
4	20	Aug. 1	No.....	No.....	Yes, 1917.....	Associated with No. 11 who had an attack. Also exposed at Lawrence, Mass., on furlough from Deer Island.
5	19	Sept. 15	No.....	No.....	No.....	Tonsilitis, 1914; sore throat every winter.
6	21	Sept. 13	No.....	No.....	No.....	
7	18	Oct. 24	No.....	Probably about Oct. 1.	No.....	Not noted in official medical record, but history very suggestive.
8	21	Sept. 21	At Brooklyn Navy Yard, Sept. 17–20.	No.....	No.....	
9	19	July 28	No.....	No.....	No.....	
10	23	Aug. 15	No.....	No.....	No.....	
11	18	July 31	No.....	Yes[1].....	No.....	Influenza attack Sept. 16.
12	19	June 11	No.....	No.....	Yes, 1917.....	Fairly typical history of attack in 1917.

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TABLE I.—*List of volunteers, Boston experiments, November and December, 1918*—Continued.

No.	Age.	Possible exposure to influenza during present epidemic, 1918.		History of attack of influenza or "grippe."		Remarks.
		On Deer Island since—	Previous to arrival at Deer Island.	Epidemic, 1918.	Previous to epidemic, 1918.	
13	20	Aug. 10	No	No	No	
14	20	July 19	No	No	No	History of close contact at Deer Island.
15	20	Sept. 25	At New York receiving ship.	Yes [1]	No	Influenza Sept. 18 at receiving ship, N. Y.
16	31	Oct. 5	Norfolk, Va., Sept. 15–Oct. 1.	No	No	
17	20	June 26	No	No	Doubtful, Apr., 1918.	
18	19	Sept. 2	No	No	No	
19	21	Sept. 4	No	No	No	
20	19	Oct. 4	No	No	No	
21	19	Oct. 4	Norfolk, Va., in brig, Sept. 25.	No	No	
22	20	June 26	No	No	No	History of close contact.
23	19	Oct. 4	No	No	No	
24	19	Aug. 31	No	No	No	
25	19	Sept. 3	No	No	Probable, 1916	
26	18	Sept. 1	No	No	No	
27	19	July 4	No	Doubtful, Sept. 30.	Doubtful, 1917	
28	17	Sept. 19	At Brooklyn Navy Yard, Sept. 11–18.	No	No	
29	18	Sept. 15	No	No	No	
30	19	Aug. 17	No	No	No	
31	20	Aug. 15	No	No	No	
32	21	Oct. 4	Norfolk, Va., in brig.	No	No	
33	19	Aug. 22	No	No	Probable, 1915.	Epidemic in New Haven at time.
34	15	Aug. 21	No	Yes, Sept. 15.	No	Not noted in official health record, but history of attack quite clear.
35	19	May 28	No	No	No	
36	19	June 17	No	No	No	
37	19	Aug. 30	No	No	No	Close contact with No. 60.
38	20	July 3	No	No	No	Close contact at Deer Island.
39	18	Oct. 21	No	No	No	
40	25	Sept. 12	No	No	No	
41	19	Sept. 19	At Brooklyn, in brig, Sept. 14–18.	Probable Aug. 8 on U. S. S. Frank H. Buck.	No	
42	19	Sept. 13	No	No	No	Close contact with No. 58.
43	34	Oct. 24	At Brooklyn, in brig, Aug. 25–Oct. 23.	No	Doubtful	
44	21	Sept. 28	No	No	No	
45	29	Sept. 28	No	No	No	
46	20	Oct. 5	No	No	No	
47	18	Sept. 25	At Brooklyn, in brig, Sept.	No	No	Close contact at Brooklyn and Deer Island.
48	20	Aug. 31	No	No	No	
49	18	Sept. 4	No	No	No	
50	20	June 26	No	No	No	
51	19	June 26	No	No	Doubtful, 1916	
52	19	Aug. 22	No	No	No	
53	18	Nov. 1	At Philadelphia, Apr. 19–Oct. 31.	No	No	Intimate contact at Philadelphia.
54	20	Sept. 6	No	Yes [1]	No	
56	21	Aug. 22	No	Yes, Sept. 23 [1]	No	
57	20	Aug. 22	No	Yes, Sept. 29 [1]	Probable, 1915	
58	21	Aug. 22	No	Yes, Sept. 22 [1]	No	
59	21	Sept. 3	No	Yes, Sept. 9 [1]	No	
60	20	Aug. 24	No	Yes, Sept. 22 [1]	No	
61	22	Sept. 11	No	Yes, Sept. 29 [1]	Probable several attacks.	
62	18	Mar. 28	No	Yes, Sept. 24 [1]	No	
63	20	July 1	No	No	No	

Naval Health Record.

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Influenza had burnt itself out on Deer Island, and the possibility that the volunteer subjects of our experiments might be insusceptible was given careful consideration. While planning the program we even doubted the desirability of working with men who had so recently been exposed. In other words, it was logical to assume that these men having passed through the fire might not be burned because they were fireproof.

While this question of the susceptibility of the volunteer subjects has been a matter of concern throughout the work, we hoped to neutralize this factor by using 10 or more men for each experiment, assuming that in so large a group a sufficient number would be susceptible, especially to large amounts of the infecting virus.

Recognizing the drawback presented by the uncertain receptivity of our subjects, it seemed desirable to take advantage of any opportunity to work with subjects not known to have been exposed to the prevailing epidemic, and thus more probably susceptible. Learning of such possible group at the naval training station at Yerba Buena Island, San Francisco, a party of workers was dispatched from Washington jointly by the Public Health Service and the Bureau of Medicine and Surgery of the Navy, to attempt a similar study. The report of this party appears in this bulletin, page 42.

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TABLE II.—*Summary of Boston experiments, November and December, 1918.*

	Date, 1918.	Material.					Recipients.		Remarks.
		Kind.	Source.		Quantity.	Mode of inoculation.	Presumably non-immunes.	With doubtful or definite history of previous attack.	
			Donor	Stage of illness.					
1	Nov. 13	Pfeiffer's bacillus, saline solution suspension	W. K.	Second day	Approximately ⅛ loopful of an 18-hour culture.	Instilled into nose	Nos. 2, 13, 30	Nos. 57, 58, 60.	No appreciable effect.
2	Nov. 16	A. Secretions from upper air passages in saline solution; unfiltered	W. W. D. K. J. J. F. D. E.	Third day. do. Fourth day	Not measured	Instilled into nose and sprayed into nose and throat.	Nos. 5, 24, 26, 29, 31, 32, 35, 63.	Nos. 25, 33	The inoculations were made 5 to 5½ hours after securing secretions. One of the volunteers, No. 29, developed fever 36 hours after inoculation, considered as probably due to an inflamed throat, but influenza could not be excluded. The others showed no reaction
		B. Same as A after filtration through Mandler filter.			Not measured	Same as with A (see also remarks).	Nos. 9, 14, 16, 18, 19, 21.	Nos. 1, 3, 4, 27.	Nos. 16, 18, 19, 21, and 27 also received instillation in the eyes. Inoculations were made 4 to 4½ hours after securing secretions. No appreciable reactions.
3	Nov. 21	Secretions from upper air passages in saline solution; unfiltered.	A. B. M. C. R. G. J. J. H. L. W.	62 hours after onset 38 hours after onset 58 hours after onset 44 hours after onset	Not measured	Instilled into nose, eyes and sprayed into nose and throat.	Nos. 8, 10, 20, 22, 40, 45, 46, 49, 53.	No. 43	Inoculations made about 1 hour and 40 minutes after securing secretions. No appreciable reactions.
4	Nov. 23	Secretions from nose and naso-pharynx.	F. H. H. B. R. H. M. R. J. R. E. L. S. T. J. K. L. P. McC. J. O. A. H. M. McL. C. F.	57 hours after onset 33 hours after onset 70 hours after onset 45 hours after onset 55 hours after onset 57 hours after onset 42 hours after onset 31 hours after onset 57 hours after onset 51 hours after onset	.....	Transfer by swab from nose to nose and throat to throat.	Nos. 9, 35 No. 14 No. 5 ..... Nos. 16, 32 No. 63 Nos. 18, 19 No. 21 Nos. 24, 26 No. 31	..... No. 33 No. 4 Nos. 3, 25 ..... No. 1 ..... No. 27	The time elapsing between donor and recipient did not exceed 30 seconds in any instance. No appreciable reactions.

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5	Nov. 25	Filtered secretions from upper air passages.	R. W. F. M. V. B. C. H. R. F. J. E. F. J.	46 hours after onset. 8 hours after onset. 7 hours after onset. 31 hours after onset. 73 hours after onset.	Not measured.	Subcutaneous	Nos. 20, 28, 36, 37, 38, 42, 44, 52.	Nos. 17, 51.	Interval between securing secretions and inoculation varied between 2 and 5 hours. No appreciable reactions. The donors in this experiment also furnished the blood for the next experiment (No. 6).
6	Nov. 25	Blood from venous circulation.	R. W. F. M. V. B. C. H. R. F. J. E. F. J.	50 hours after onset. 12 hours after onset. 11 hours after onset. 35 hours after onset. 77 hours after onset.	1.5 c. c. from each of the 5 donors.	Subcutaneous	Nos. 2, 6, 13, 23, 30, 39, 47, 48.	Nos. 11, 12.	Interval between drawing blood and inoculation not over 45 minutes. No appreciable reactions.
7	Nov. 26	"Droplet," breath, and close contact.	N. T. C. F. L. M. Y. E. N. W. A. K. A. L. F. L. W. G. W. F. B. E. C. B. B. C. L. M. V.	21 hours after onset. 10 hours after onset. 27 hours after onset. 56 hours after onset. 30 hours after onset. 72 hours after onset. 24 hours after onset. 84 hours after onset. 34 hours after onset. 34 hours after onset.	.....	Direct exposure in close contact for from 3 to 5 minutes to each donor.	Nos. 8, 10, 20, 22, 40, 45, 46, 49, and 53.	No. 43.	No appreciable reactions.
8	Dec. 2	Pfeiffer's bacillus, suspension in saline solution of 13 strains. Strains 1 to 13, Table III.		See table.	0.5 c. c. of suspension representing about one billion organisms.	Sprayed into nose and throat.	Nos. 6, 20, 28, 37, 38, 39, 44, 48, and 52.	Nos. 7, 15, 34, 41, 51, 54, 56, 59, 60, 61.	About 48 hours after inoculation volunteer No. 38 complained of headache and sore throat and temperature rose to 38° C. Next day temperature was normal and he remained well. Otherwise nothing of significance.

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DESCRIPTION OF EXPERIMENTS.

EXPERIMENT NO. 1—WITH A SINGLE CULTURE OF B. INFLUENZAE.

On November 13, 1918, we inoculated six men with a saline suspension of a culture of Pfeiffer's bacillus. Three of the men (Nos. 2, 13, and 30) were nonimmunes, i. e., were not known ever to have had an attack of influenza; the other three (Nos. 57, 58, and 62) were presumably immune, having a history of an attack of the disease during the recent epidemic, and were used as controls.

The culture (No. 14) was isolated from the sputum of a case (W. K.)[1] on November 9, the second day of the disease. When used, it was an 18-hour blood-agar culture, the fifth generation on artificial media. Approximately one loopful of the 18-hour culture was rubbed up in 6 c. c. of saline solution and 1 c. c. of this suspension instilled into the nose of each of the six subjects. The instillation was made with the subject on his back, about 0.5 c. c. being instilled into each nostril.

Results.—No appreciable effects were observed following this inoculation.

EXPERIMENT NO. 2—CRUDE AND FILTERED SECRETIONS.

On November 16 secretions were secured from the upper respiratory passages of three cases of influenza at the Peter Bent Brigham Hospital. Two of the cases (W. W. D. and K. J. J.) came from a barracks building of a school in which there was an outbreak of influenza. The third case (F. D. E.) was that of a student from another school at which there was an outbreak of the disease. The first two cases (W. W. D. and K. J. J.) were in the third day of their illness, and the third (F. D. E.) in the fourth day, when the secretions were secured.

At about 12 o'clock noon, mouth, nasal, and pharyngeal washings, bronchial sputum, pharyngeal and nasopharyngeal swabs were collected in sterile physiological saline solution from each of the cases and the three sets of specimens pooled in a single sterile bottle and shaken with beads. Part of these pooled secretions was filtered through Mandler filters, the filtration lasting about 2.4 hours. The secretions were taken to Gallups Island and there used for the following inoculations:

(*a*) *Unfiltered secretions.*—The crude secretions in saline solution were used for the inoculation of 10 men. This inoculation was made between 5 and 5.30 p. m., or approximately 5 to 5½ hours after the secretions were secured. The recipients were Nos. 5, 24, 25, 26, 29, 31, 32, 33, 35, and 63. None of these men had a history of an attack of disease during the recent epidemic. One (No. 33), however, had a history of having had an influenza-like attack in 1[illegible] (No. 25) gave a history of an illness in 1916 which

[1] See history of cultures for details, Table III; Appendix B, page 28.

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may have been such an attack, thus leaving eight of the men without a history of influenza or influenza-like sickness at any time.

The inoculation was made by spraying the nose and throat and by instilling into the nostrils. It was estimated that each man received in these ways, in all, between 5 and 6 c. c. of the mixed unfiltered suspension of the secretions.

(*b*) *Filtered secretions.*—The filtrate obtained by passing the secretions through Mandler filters was used for the inoculation of 10 men. The inoculation was made between 4.30 and 5 p. m., or 4 to 4½ hours after the secretions were collected. The recipients were Nos. 1, 3, 4, 9, 14, 16, 18, 19, 21, and 27.

Of these 10 men 8 were without a history of an attack of the disease during the recent epidemic. One (No. 1) is reported to have had an attack in September, and one (No. 27) gave a doubtful history of such an attack.

Of 2 of the men who gave no history of influenza during the recent epidemic, one (No. 4) gave a history of an influenza-like attack in 1917; the other (No. 3) gave a doubtful history of such attacks in 1916 and 1917, so that of this group of 10 men, 6 were without history of influenza or influenza-like sickness at any time. The inoculation was made by spraying the nose and throat and by instillation into the nose. In the case of 5 of these men, viz, 16, 18, 19, 21, and 27, a drop or two of the filtrate was also instilled into each eye. In all, each of the 10 men received not less than 5 c. c. of the filtrate.

In both the group of men receiving the crude, and in that receiving the filtered secretions some, if not all, of the men in all probability swallowed some of the material.

Results.—With one exception, none of the above two groups of men developed any unpleasant effects. The exception was that of volunteer No. 29, inoculated with unfiltered secretions. About 36 hours after the inoculation, this young man's temperature rose and remained above normal for a week. (See chart 1.) Subjectively, he made almost no complaint; his tonsils, which before the inoculation were noted to be considerably enlarged, became somewhat more swollen and red. The submaxillary glands were slightly enlarged and somewhat tender. The only other physical findings were a few coarse râles, heard posteriorly at lower angle of the right scapula, which persisted for several days. Once or twice he mentioned some indefinite pains in the chest and some soreness of the throat. These poorly defined subjective symptoms were not complained of until about 30 hours after his rise in temperature.

There was no complaint of weakness, nor was there any appearance of prostration. Blood examination showed on November 19, W. B. C. 8,000, on November 20, 6,000, and on November 21, 9,000. Throat culture on November 20 showed hemolytic and also green producing streptococcus colonies.

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On November 20 he was seen with us in consultation by Lieut. Commander McGuire, United States Navy, and Lieut. Redden, United States Naval Reserve Force. It was agreed that the manifestations recorded were probably due to the inflamed condition of the throat, but a diagnosis of influenza could not positively be excluded.[1]

EXPERIMENT NO. 3—CRUDE SECRETIONS.

On November 21, 1918, secretions were secured from the upper respiratory passages of four cases of influenza at the Chelsea Naval Hospital and used for the inoculation of 10 men. The interval between the collection of the secretions and inoculation was one hour and 40 minutes.

The donors were A. B. M., who furnished the secretions about 62 hours after the onset of his symptoms; C. R., who furnished secretions about 38 hours after the onset; G. J. J., who furnished secretions about 58 hours after the onset; and H. L. W., who furnished secretions about 44 hours after the onset.

The secretions were secured by washing out the nose with physiologic salt solution, by swabbing the pharynx and naso-pharynx, and by having the donors cough and expectorate bronchial and buccal secretions into a sterile receptacle.

The secretions from the four cases were mixed and shaken in a sterile bottle with glass beads. In transit to Gallups Island the bottle containing the secretions was carried in the pocket in order to prevent too great chilling. The interval elapsing between the collection of the material and the completion of the inoculation was 1 hour and 40 minutes.

The inoculations were made by spraying the crude material into the nose and throat, and by instilling some of it into the eyes and nose of each of the 10 volunteers. Approximately 6 c. c. of the saline suspension was given to each volunteer. The recipients, 10 in number, were volunteers Nos. 8, 10, 20, 22, 40, 43, 45, 46, 49, and 53. Of these 10 men none had a record of influenza during the recent epidemic; 1 (No. 43), however, had a doubtful history of a previous influenza-like attack.

Results.—None of these men experienced any unpleasant effects following the inoculation.

EXPERIMENT NO. 4.—DIRECT TRANSFER OF SECRETIONS FROM NOSE TO NOSE AND THROAT TO THROAT.

On November 23, 1918, 19 of the 20 men used in experiment No. 2, having been under observation for seven days and not having shown

[1] He subsequently developed an attack of influenza, lasting from Jan. 28 to Feb. 4, while [illegible] City.

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any evidence of illness (with the single exception, No. 29, already discussed), were submitted to another test.

It occurred to us that our failure to reproduce the disease thus far might be due to several factors, two of which we decided to eliminate. These two factors were (1) the time which elapsed between collecting the material from the donors and introducing it into the volunteer recipients, and (2) the salt solution. By transferring the secretions directly from nose to nose, and from throat to throat, the time interval was reduced to a minimum, and the salt solution eliminated.

In this experiment, then, cotton applicators, consisting of "diphtheria swabs," were used to transfer the muco-purulent secretions directly from nose to nose; and "West tubes" were used to transfer the material from throat to throat. The time interval between donor and recipient was not over 30 seconds.

In this experiment there were 10 donors, from each of which transfers of secretions were made to each of a pair of recipients, with one exception, in which there was only a single recipient.

In the manner described, nasal and naso-pharyngeal secretions were transferred:

(*a*) From case F. H. H., 57 hours after onset of illness, to volunteers Nos. 9 and 35, neither of whom had a history of an attack of influenza at any time.

(*b*) From case B. R. H., 33 hours after the onset, to volunteers Nos. 14 and 33, neither of whom had a history of influenza in the recent epidemic, but one of whom (No. 33) had a history of an influenza-like attack in 1915.

(*c*) From case M. R. J., 70 hours after the onset, to volunteers Nos. 4 and 5, neither of whom had a history of an attack during the recent epidemic, but one of whom (No. 4) gave a history of an influenza-like attack in 1917.

(*d*) From case R. E. L., 45 hours after the onset, to volunteers Nos. 3 and 25, neither of whom had a history of influenza during the recent epidemic, but both of whom gave a more or less doubtful history of an influenza-like attack, No. 3 in 1916 and 1917, and No. 25 in 1916.

(*e*) From case S. T. J., 55 hours after the onset, to volunteers Nos. 16 and 32, neither of whom had a history of influenza at any time.

(*f*) From case K. L. P., 57 hours after the onset, to volunteers Nos. 1 and 63, the former of whom (No. 1) had a history of an attack during the recent epidemic, while the latter (No. 63) was without history of the disease at any time.

(*g*) From case McC. J., 42 hours after the onset, to volunteers Nos. 18 and 19, neither of whom had a history of the disease at any time.

(*h*) From case O. A., 31 hours after the onset, to volunteers Nos. 21 and 27, the former of whom (No. 21) was without a history of

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influenza at any time, while the latter (No. 27) gave a doubtful history of a mild attack, both during the recent epidemic and in 1917.

(*i*) From case H. M., 57 hours after the onset, to volunteers Nos. 24 and 26, neither of whom had a history of influenza at any time.

(*j*) From case McL. C. F., 51 hours after the onset, to volunteer No. 31, who had no history of ever having had an attack of influenza.

All of the donors above mentioned were from the U. S. S. *Yacona*.[1]

Results.—None of the volunteers showed any unpleasant effects following the inoculation.

EXPERIMENT NO. 5—SUBCUTANEOUS INJECTION OF FILTERED SECRETIONS.

November 25, 1918. This experiment was designed to test the infectivity of filtered secretions from the upper air passages of cases of influenza when given subcutaneously, following Nicolle and Lebailly.[2]

On November 25 secretions were obtained as nasal, pharyngeal and mouth washings, bronchial sputum, and pharyngeal swabs, in sterile physiological solution from case R. W. F., 46 hours after onset of illness, from case M. V., 8 hours after the onset, and from case B. C. L., 7 hours after the onset, mixed and shaken with beads.

Secretions were similarly secured from case R. F. J., 31 hours after the onset, and from case E. F. J., 73 hours after the onset, likewise mixed and shaken with beads. The two sets of specimens of secretions were then separately filtered through Mandler filters; the first through filters with 11 pounds positive pressure value, the second through a filter of 9 pounds pressure value. After filtration, 2.5 c. c. of the filtrate of the first of the two specimens and about 2 c. c. of the filtrate of the second were subcutaneously inoculated into each of the following 10 volunteers, Nos. 17, 20, 28, 36, 37, 38, 42, 44, 51, and 52.

Of these men, none gave a history of an attack during the recent epidemic. One (No. 17) gave a doubtful history of an influenza-like attack in April, 1918, and one (No. 51) gave a history of such an attack in 1916. Of this group, therefore, eight were without a history of influenza or influenza-like illness at any time.

The time that elapsed between securing the secretions and the inoculation of the men with the filtrate was about 2 to 2.5 hours with respect to the first of the two sets of specimens above mentioned and about 5 hours with respect to the filtrate of the second set.

Results.—None of the men developed any appreciable reaction following this inoculation.

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[1] [illegible] vol.

[2] C. Rend. Acad. d. Sc., 1918, vol. 167, p. 607.

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EXPERIMENT NO. 6—SUBCUTANEOUS INJECTION OF BLOOD FROM INFLUENZA CASES.

November 25, 1918. This experiment was designed to test the infectivity of the blood of cases of influenza, when inoculated subcutaneously, following Nicolle and Lebailly.[1] On November 25 blood was drawn from the venous circulation (arm vein) of each of five cases of influenza; the patients were the same as those furnishing the secretions in the immediately preceding experiment (No. 5) but about 4 hours later, so that when the blood was drawn the patients were from 11 to 77 hours after the onset of their illness. About 20 c. c. of blood was drawn from each patient into a syringe containing about 4 c. c. of sterile 5 per cent sodium citrate solution. The five specimens of blood thus drawn were pooled and 10 c. c. (representing approximately 1.5 c. c. of undiluted blood from each of the five cases) subcutaneously injected into each of the following volunteer subjects: Nos. 2, 6, 11, 12, 13, 23, 30, 39, 47, and 48. Of these men, nine were without history of an attack during the recent epidemic, one (No. 11) had such history, and of the nine, one (No. 12) had a history of an influenza-like attack in 1917, so that of the group, eight were without history of influenza or influenza-like illness at any time.

Of this group of subjects, three—Nos. 2, 13 and 30—had been used previously in experiment No. 1 (inoculation with Pfeiffer's bacillus).

The interval between drawing the blood and inoculating it did not exceed 45 minutes in any case.

Results.—Aside from slight soreness at the site of inoculation lasting not over 24 hours, there was no appreciable effect following the inoculation.

EXPERIMENT NO. 7—DIRECT CONTACT.

November 26, 1918. This experiment was designed to test the transmissibility of influenza by what is assumed to be the natural means, viz, by the expired breath and cough.

The 10 volunteers previously used in Experiment No. 3, in which they were inoculated with mixed unfiltered secretions from the upper respiratory passages from active cases of influenza, were used in the present experiment. They were taken to the naval hospital at Chelsea and in a ward in which 30 cases of influenza were being treated, were exposed to infection from 10 especially selected acute cases, as follows:

Case N. T. C., about 21 hours after onset of illness; case F. L. M., about 10 hours after onset of illness; case Y. E., about 27 hours after

[1] Loc. Cit.

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onset of illness; case N. W. A., about 56 hours after onset of illness; case K. A. L., about 30 hours after onset of illness; case F. L. W., about 72 hours after onset of illness; case G. W. F., about 24 hours after onset of illness; case B. E. C. B., about 84 hours after onset of illness; case B. C. L., about 34 hours after onset of illness; case M. V., about 34 hours after onset of illness.

Each volunteer took a position close to the bedside of one of the selected patients and conversed with him for two or three minutes, then the patient was directed to breathe five times and then cough five times directly into the face of the volunteer. After this was done the volunteer proceeded to the bedside of a second patient. In this manner each of the volunteers was exposed in succession to each of the 10 selected cases, the exposure to each being between three and five minutes. The total exposure for each volunteer, therefore, was between 30 and 50 minutes.

Results.—None of these volunteers developed any indications of illness following this exposure.

EXPERIMENT NO. 8—INSTILLATION OF A MIXTURE OF 13 DIFFERENT STRAINS OF PFEIFFER'S BACILLUS.

On December 2, 1918, we inoculated 19 volunteers with a suspension in a saline solution of 13 strains of pure culture, of Pfeiffer's bacillus. Of the volunteers 10 (Nos. 6, 20, 28, 37, 38, 39, 44, 48, 51, and 52) were nonimmunes, i. e., were without history of an attack of influenza in the recent epidemic, and, with one exception (No. 51) were without a history of an influenza-like attack at any time. In the case of this one man (No. 51) there was a history of what may have been an influenza-like attack in 1916. The other nine volunteers, viz, Nos. 7, 15, 34, 41, 54, 56, 59, 60, and 61, had histories of a definite, or (in two instances, Nos. 7 and 41) a probable attack of the disease during the recent epidemic and served as controls.

A memorandum relative to the origin of the strains of Pfeiffer's bacillus, with certain other pertinent data, is given in Appendix B and a summary is presented in Table III. All 13 strains were isolated from cases of influenza occurring during the recent epidemic. Four of the strains were isolated within five days of the date of inoculation and had been on artificial culture media for not over five generations; two of them, indeed, had been on artificial media for not over 48 hours at the time of inoculation.

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TABLE III.—*Cultures used in Boston experiments November and December, 1918.*

No.	Culture.		Interval between isolation of culture and inoculations.	Medium.	Transplant used.
	Designation.	Source.			
1	McC	Lungs at necropsy	5 days	Heated and filtered blood agar.	Fifth.
2	K-OC	Nasopharynx, life	48 hours	do	First.
3	K-CF	do	do	do	Do.
4	U-W	Lungs at necropsy	5 days	do	Fourth.
5	H-E	Washed bronchial sputum, life.	13 days	do	Seventh.
6	Youngstown	Lungs at necropsy	12 days	do	(?)
7	P-BH (123)	do	26 days	do	Fifteenth (?).
8	Card	do	38 days	do	
9	Staizecki	do	do	do	
10	Butler	Lungs, life (?)	do	do	
11	CD (112)			do	
12	CD (157)			do	
13	Park (103)			do	
14	WK	Sputum, life, second day	5 days	Whole blood agar	Fifth.

See Appendix B, p. 28.

Each of the strains was planted on special blood agar slants[14] on December 1 at 3 p. m. at the laboratory of the Chelsea Naval Hospital. This medium was prepared by adding 10 per cent of defibrinated sheep's blood to melted plain agar, neutral to phenolphthalein, and then boiling and filtering through sterile gauze, the resulting medium being perfectly clear and very favorable to the growth of Pfeiffer's bacillus.

At 11.15 a. m. December 2, the cultures were taken from the incubator, placed in a warm box, and thus transferred to Gallups Island, where they were placed in an incubator at 1 p. m. At 1.45 p. m. a suspension of the growth of each strain on a slant was made in a total of 25 c. c. of warm dextrose beef broth. The growth from but a single slant was used in the case of all strains except Nos. 1, 2, and 3. Of the latter the growth from two slants of each of strains Nos. 1 and 2 and of four from No. 3 was used; thus, in the preparation of the suspension, the growth from eighteen slants in all was used, and the suspension included increased proportions of three of the most recently isolated strains.

A bacterial count of the suspended bacilli by Wright's capillary tube method in comparison with red blood cells showed approximately 2 billion per cubic centimeter.

The inoculation was made between 2.05 and 2.22 p. m. by spraying this suspension into the nose and pharynx, the volunteer taking a deep inhalation when the throat was sprayed. In this manner each man received approximately 0.5 c. c. of the suspension containing about 1 billion bacilli.

[14] Levinthal, W., Influenza. Bakteriologische und serologischen Studien. Berl. klin. Wchnschr. 1918, XLIV. 972. Abstracted in J. Am. Med. Association, 1918, LXXI, 1578.

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The cultures were carried back to the naval hospital and transplants made from each tube used and also from the remainder of the broth suspension. All transplants gave abundant growths of Pfeiffer's bacillus.

All cultures used were identified morphologically and culturally immediately before and after the experiment.

Results.—About six hours after the inoculation volunteer No. 28 had an attack of vomiting and complained of malaise which, however, had begun before the inoculation. His temperature did not rise above normal and he appeared well the next day and remained so.

About 48 hours after the inoculation volunteer No. 38 complained of headache and sore throat and his temperature rose to 38° C. The next day his temperature was normal and he appeared well, and remained so throughout the remainder of the period of close observation of seven days.

Aside from the foregoing developments all of the volunteers remained in good health; none showed any evidence of influenza.

SUMMARY.

Subjects.—Sixty-two volunteers, varying in age from 15 to 34 years, were the subjects of experiment. Of these 39 were without history of an attack of influenza at any time; 14 gave a history of this disease; and 9 had a history of attacks of a doubtful nature. All, however, had been exposed in varying degrees to the epidemic at Deer Island or at a previous station or place.

Experiments.—Eight experiments were made: In two, pure cultures of Pfeiffer's bacillus were used, inoculations being respectively by instillations into the nose and spraying of the nose and throat.

In two, unfiltered secretions from the upper respiratory passages were sprayed into the nose and throat; in one of these some of the secretions were also instilled into the eyes.

In one, filtered secretions from the upper respiratory passages were sprayed into the nose and throat and instilled into the eyes, and in another experiment such a filtrate was injected subcutaneously.

In one experiment direct transfers of secretions from nose and nasopharynx by means of swabs were made from nose to nose and from nasopharynx to nasopharynx.

In one experiment freshly drawn citrated blood was injected subcutaneously.

In one experiment there was exposure by close contact to expired breath and "droplet" infection.

Donors.—The experimental material was obtained from and exposure made to cases of influenza in various stages of the disease and of different grades of severity. The donors were selected from epidemic groups, thus minimizing the chance of mistake in selecting isolated cases. The crude secretions were obtained from

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cases in the second, third, and fourth days of the disease. The secretions in one of the filtration experiments (inoculated subcutaneously) were from cases as early as the eighth and ninth hour after the onset. In the contact and droplet infection experiment the donors were from 10 to 84 hours after the onset of their respective attacks, and in the blood inoculation experiment the donors were from 11 to 77 hours after the beginning of their sickness.

Results.—In only one instance (Experiment 2 (*a*)) was any reaction observed in which a diagnosis of influenza could not be excluded, and here a mildly inflamed throat seemed the more probable cause of the fever and other symptoms. Nothing like influenza developed in the other volunteers.

DISCUSSION OF RESULTS.

The results of our experiments do not warrant positive conclusions. The negative character of our results is surprising when we call to mind the very high communicability of the disease and the fact that the incidence rate in the recent epidemic was usually 20 per cent, often 30 per cent or more of the population. The incidence of the disease on the U. S. S. *Yacona*, from which we took a number of donors, was 84.2 per cent.

In explanation of our failure to reproduce the disease, many factors naturally suggest themselves for consideration. Among these, the susceptibility of the volunteers and the stage of the disease at which the secretions from the upper respiratory passage were secured stand out as perhaps of the first order.

It is possible that all our volunteers resisted infection because of a natural or an acquired immunity. If this be true, then we have an indication of a much higher degree of immunity to this disease than is generally assumed. The fact that our colleagues in the San Francisco studies (q. v. p. 53) failed to reproduce the disease in volunteers who had not been exposed in the recent pandemic suggests that the immunity of our volunteers was at least not the sole controlling factor.

Epidemiological evidence points to the likelihood that influenza is most communicable during its early stages. Most of our material was obtained during the first, second, or third days of the disease, sometimes as early as the eighth or tenth hour after the beginning of symptoms. In no case, however, did we obtain material during the period of incubation. If our volunteers were susceptible, then it could be argued that the material used did not contain the virus.

Despite our negative results, it is nevertheless probable that the disease is transmitted by the discharges from the mouth and nose. Our failure, however, to reproduce the disease with these discharges suggests that there may be unknown factors involved, either in the discharge of the virus from the body, or its entrance into the victim, or both.

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Not only do
NONE OF THE 62 VOLUNTEERS BECOME SICK

but, as we can see in Appendix A,
ALL 30 DONORS with Spanish Flu symptoms RECOVER FROM THE SPANISH FLU

APPENDIX A.

DONORS.

A. B. M. (Sea-1, age 23, U. S. S. *New Jersey*).—The onset of illness was Monday, November 18, at midnight. The patient awoke feeling hot, dizzy, nauseated, and weak. He had a bad headache, and his bones and joints ached. He reported to sick bay Tuesday morning with a temperature of 101° F. He had no sore throat or chest pains; an occasional cough. The leucocyte count November 21 was 7,200, polymorphonuclears 76 per cent, mononuclears 24 per cent. (Chart 2.)

This patient gave no previous history of influenza, although having been in very close contact with it on the ship during an outbreak about October 1. He was perfectly well preceding this attack and recovered without complications.

Furnished secretions from upper respiratory passages on November 21 between 2.20 and 2.35 p. m. for use in Experiment No. 3.

B. C. L. (Sea-2, age 19, U. S. S. *Yacona*).—The onset of illness was Monday, November 25, at 6 a. m. The patient awoke with a headache, a slightly sore throat, chilly sensations, and eyes sensitive to light. The leucocyte count November 27 was 4,500, polynuclears 52 per cent, lymphocytes 58 per cent. He recovered without complications. (Chart 3.)

On November 25, at 1 p. m., seven hours after the onset, this patient furnished secretions from the mouth, pharynx, and bronchi, which were used in Experiment No. 5, and four hours later (11 hours after the onset) blood, which was used in Experiment No. 6. He was used a third time, November 26, 34 hours after the onset, in Experiment No. 7, for direct exposure of volunteers.

B. R. H. (El-1, age 26, U. S. S. *Yacona*).—The onset of illness was Friday, November 22, at 6 a. m. The patient felt well the night before. He awoke with headache, pains in his back, a slight cough, eyes and nose congested. The leucocyte count November 23 was 8,200, polynuclears 73 per cent, lymphocytes 25 per cent, transitionals 3 per cent. He recovered, with questionable pneumonic complications. (Chart 4.)

On November 23, 1918, 33 hours after the onset, this patient furnished secretions from the nasal fossae and posterior nasopharynx, which were used in Experiment No. 4.

B. E. C. B. (Ch. Com. St., age 26, U. S. S. *Yacona*).—The onset of illness was Saturday, November 23, at 6 a. m. The patient felt tired Friday, with a slight headache; Saturday he felt tired all over, with backache. He had no sore throat. The leucocyte count November 27 was 3,600, polynuclears 61 per cent, lymphocytes 38 per cent, transitionals 1 per cent. Recovered, with questionable pneumonic complications. (Chart 5.)

On November 26, 1918, 84 hours after the onset, this patient was used in Experiment No. 7 for direct exposure of volunteers.

C. R. (Sea-2, age 28, radio school).—The onset of illness was Tuesday, November 19, at midnight. The patient felt dizzy, with headache, vomiting, and pains in his legs. He first sweat and then felt cold. He had no sore throat. He felt perfectly well T[illegible]ning, before midnight. The leucocyte count November 21 was 6,400, [illegible] per cent, lymphocytes 43 per cent, transitionals 1 per cent, basophiles [illegible]overed, without complications. (Chart 6.)

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He gave no previous history of influenza, although he was at the radio school during the first outbreak there. He said the sick bay was full of similar cases the day he reported, November 20.

On November 21, at about 2.20 p. m. (or about 38 hours after the onset) furnished secretions from upper respiratory passages for Experiment No. 3.

F. F. J. (Sk-3, age 25, U. S. S. *Yacona*).—The onset of illness was Friday, November 22, at noon, when he felt weak. Friday night he felt sore all over and chilly. He had felt well before this onset. On November 25 the leucocyte count was 3,400, polynuclears 66 per cent, lymphocytes 34 per cent. Developed pneumonia. Recovered. (Chart 7.)

On November 25, 1918, 75 hours after the onset, this patient furnished secretions from the mouth, nose, pharynx, and bronchi, which were used in Experiment No. 5, and, four hours later, blood, which was used in Experiment No. 6.

F. H. H. (Qm-1, age 24, U. S. S. *Yacona*).—The onset of illness was Thursday, November 21, at 6 a. m. He awoke with headache, chilliness, pains in his muscles and joints, a dry throat and chest, and an occasional cough. He felt weak the night before. His temperature at sick bay Thursday morning was 102.2°. The leucocyte count November 23 was 9,400, polynuclears 58 per cent, lymphocytes 38 per cent, transitionals 4 per cent. Recovered, with questionable pneumonic complications. (Chart 8.)

On November 23, 1918, 57 hours after the onset, this patient furnished secretions from the nasal passages and posterior nasopharynx, which were used in Experiment No. 4.

F. D. E. (student, age 19, female).—The onset of influenza was November 12. Initial symptoms were a severe headache and backache; some cough and fever. Leucocyte count November 15 was 6,400, polynuclears 51 per cent, lymphocytes 48 per cent, eosinophiles 1 per cent. Recovered without complications. (Chart 9.)

On November 16, about 12 m., on the fourth day of illness, furnished secretions for Experiment No. 2.

F. L. M. (Sea.-2, age 18, U. S. S. *Yacona*).—The onset of illness was Tuesday morning, November 26; the only symptom was a fever of 101°. Had no aches or pains. November 27 the leucocyte count was 5,400, polynuclears 53 per cent, lymphocytes 41 per cent, transitionals 3 per cent, basophiles 1 per cent, eosinophiles 2 per cent. Recovered without complications. (Chart 10.)

On November 26, 1918, 10 hours after the onset, this patient was used in Experiment No. 7 for direct exposure of volunteers.

F. L. W. (Sea.-1, age 20, U. S. S. *Yacona*).—The onset of illness was Saturday, November 23, in the afternoon. It began with headache, weakness, aching in bones and joints. The patient felt dizzy, his throat was dry, and he coughed a little. The leucocyte count on November 27 was 3,400, polynuclears 40 per cent, lymphocytes 60 per cent. Recovered without complications. (Chart 11.)

On November 26, 1918, 72 hours after the onset, this patient was used in Experiment No. 7.

G. J. J. (El-R., age 22, radio school).—The patient had been in the radio school, Cambridge, Mass., since the first appearance of pandemic influenza in Boston, and had been in contact with cases of influenza at the radio school and in Boston during the outbreak of the early part of September. He did not contract the disease at that time. A recurrent outbreak occurred at the radio school soon after the Liberty Day celebrations of November 11 and 12. There were about 80 cases in the sick bay at the time G. J. J. entered, mostly of very mild type.

The onset of illness was Tuesday, November 19, at 4 a. m. The initial symptoms were a dizzy headache, aches in the back and legs, and some pain in the stomach. There was no vomiting. The onset was sudden, except that on the preceding day at 5 p. m. the patient had felt a little poorly, and had applied at the sick bay for a

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dose of salts. He complained of no sore throat and no previous ailment of any kind. On November 24 the leucocyte count was 6,200, polynuclears 52 per cent, lymphocytes 48 per cent. Recovered without complications. (Chart 12.)

November 21, about 58 hours after the onset, furnished material for Experiment No. 3.

G. W. F. (F–2, age 27, U. S. S. *Yacona*).—The onset of illness was Monday, November 25, at 3 p. m., suddenly while on watch. The patient felt weak and ached all over. He had no sore throat or dizziness. The leucocyte count November 27 was 3,300, polynuclears 57 per cent, lymphocytes 43 per cent. Recovered, with questionable pneumonic complications. (Chart 13.)

On November 26, 1918, 24 hours after the onset, this patient was used in Experiment No. 7 .

H. L. W. (Cqm., age 29, M. I. T.).—The onset of illness was Tuesday, November 19, at 6 p. m. The patient suddenly felt quite ill, feverish, chilly, and with hot and cold flushes, a heavy feeling in his head, and aching pains in eyes and back of eyes. His extremities felt as though they were very heavy, with a mild aching, like fatigue. All day Tuesday he had felt a little ill, but the onset was definite and sudden. He had no sore throat, but had had a cold "in the head" for about three weeks, for which he had been going to sick bay occasionally. The leucocyte count November 21 was 5,400, polynuclears 50 per cent, lymphocytes 40 per cent. Recovered without complications. (Chart 14.)

The previous history showed contact with influenza during the first outbreak in Boston, without contracting it; his two little daughters had influenza at his home where he stayed.

November 21, about 44 hours after the onset, furnished material for Experiment No. 3.

H. M. (Sea., age 29, U. S. S. *Yacona*).—The onset of illness was Thursday, November 21, at 6 a. m. When the patient awoke he had pains in his head and chest. The back of his neck ached a little. He coughed considerably and had a raw throat. On November 23 the leucocyte count was 6,000, polynuclears 80 per cent, lymphocytes 14 per cent, transitionals 5 per cent, eosinophiles 1 per cent. Recovered without complications. (Chart 15.)

On November 23, 1918, 57 hours after the onset, this patient furnished secretions from the nasal fossa and posterior nasopharynx, which were used in Experiment No. 4.

K. A. L. (El–R–1, age 20, U. S. S. *Yacona*.)—The onset of illness was Monday, November 25, in the forenoon. It began with a headache between the eyes. The patient had no sore throat or backache, no chilly or warm sensations. In the afternoon he felt dizzy and coughed a little, and his temperature was 101.6°. He had been well previously, except for a mild cold for about a week. Leucocyte count November 27, 8,400. Recovered without complications. (Chart 16.)

On November 26, 1918, 30 hours after the onset, this patient was used in Experiment No. 7 for direct exposure of volunteers.

K. J. J. (S. A. T. C., age 20).—The onset of influenza was November 13, 1918, in the afternoon. The initial symptoms were a fairly severe frontal headache, fever, and hoarseness, backache and general disagreeable feeling. Leucocyte count November 15 was 5,800, polynuclears 78 per cent, lymphocytes 14 per cent, large mononuclears 9 per cent, eosinophiles 2 per cent, mast cells 1 per cent. The urine showed numerous finely granular and coarsely granular casts. Recovered without complications. (Chart 17.)

On November 16, in the third day of illness (about 72 hours after onset), furnished secretions for Experiment No. 2.

K. [illegible] 22, U. S. S. *Yacona*).—The onset of illness was Thursday, November [illegible] The patient felt slightly ill the night before. In the morning he [illegible] and backache. His throat felt a little dry and raw. On

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November 23 the leucocyte count was 5,700, polynuclears 54 per cent, lymphocytes 44 per cent, transitionals 2 per cent. Recovered without complications. (Chart 18.)

On November 23, 1918, about 57 hours after the onset this patient furnished secretions from the nasal fossae and posterior nasopharynx which were used in Experiment No. 4.

McC. J. (F–2, age 27, U. S. S. *Yacona*).—The onset of illness was Thursday, November 21, between 6 and 12 p. m. The patient came off watch at midnight and was sweating considerably. His throat was sore, head dizzy, he had chilly sensations in his chest, fever, and pains in his back. On November 23 the leucocyte count was 10,000, polynuclears 72 per cent, lymphocytes 22 per cent, transitionals 5 per cent, eosinophiles 1 per cent. Developed pneumonia. Recovered. (Chart 19.)

On November 23, 1918, about 42 hours after the onset, this patient furnished secretions from the nasal fossae and posterior nasopharynx which were used in Experiment No. 4.

McL. C. F. (Bm–1, age 24, U. S. S. *Yacona*).—The onset of illness was Thursday, November 21, at noon. It began suddenly with headache, aching in bones and muscles all over. The patient felt chilly, his eyes burned and he had a raw throat, coughing a little. On November 23 the leucocyte count was 5,800, polynuclears 75 per cent, lymphocytes 23 per cent, transitionals 2 per cent. The leucocyte count November 27, during pneumonia, was 5,000, polynuclears 50 per cent, lymphocytes 49 per cent, transitionals 1 per cent. Recovered. (Chart 20.)

On November 23, 1918, 51 hours after the onset, this patient furnished secretions from the nasal fossae and the posterior nasopharynx which were used in Experiment No. 4.

M. R. J. (Mm–1, age 22, U. S. S. *Yacona*).—The onset of illness was Wednesday, November 20, at 5 p. m. The patient felt well Wednesday morning. The initial symptoms were chilly sensations, headache, pains in shoulders and back. His eyes burned. He coughed some at night and had pains in his chest. On November 23 the leucocyte count was 4,200, polynuclears 49 per cent, lymphocytes 46 per cent, transitionals 4 per cent, basophiles 1 per cent. Recovered, without complications. (Chart 21.)

On November 23, 1918, 70 hours after the onset, this patient furnished secretions from the nasal fossae and posterior nasopharynx which were used in Experiment No. 4.

M. V. (M. Att.–3, age 22, U. S. S. *Yacona*).—The onset of illness was on Monday, November 25, at 5 a. m. It started with a severe headache, shivering, a little cough, and weakness. The patient had had a cough for three to four weeks previously. On November 25 the leucocyte count was 4,800, polynuclears 66 per cent, lymphocytes 33 per cent, transitionals 1 per cent. Recovered, without complications. (Chart 22.)

On November 25, 1918, about 8 hours after the onset, this patient furnished secretions from the mouth, nose, pharynx, and bronchi, which were used in Experiment No. 5, and 4 hours later blood, which was used in Experiment No. 6. He was used a third time on November 26, 34 hours after the onset, in Experiment No. 7.

N. T. C. (Bm–2, age 34, U. S. S. *Yacona*).—The onset of illness was Monday, November 25, at 7 p. m. The symptoms were fever, chilliness, pains all over, a slight cough, and a heavy feeling in the chest. The patient had had a slight cough two or three days previously. On November 27 the leucocyte count was 5,600, polynuclears 58 per cent, lymphocytes 38 per cent, transitionals 2 per cent, eosinophiles 1 per cent, basophiles 1 per cent. Recovered, without complications. (Chart 23.)

On November 26, 1918, about 21 hours after the onset, this patient was used in Experiment No. 7.

N. W. A. (El–R–2, U. S. S. *Yacona*).—The onset of illness was Sunday, November 24, at 8 a. m. It started with aches all over the body and flashes of heat and cold. The patient had no sore throat, and had felt well previously. On November 27 the leucocyte count was 11,000, polynuclears 79 per cent, lymphocytes 21 per cent, this associated with signs of pneumonia. Recovered. (Chart 24.)

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On November 26, 1918, about 56 hours after the onset, this patient was used in Experiment No. 7.

O. A. (F-1, age 32, U. S. S. *Yacona*).—The onset of illness was Friday, November 22, at 8 a. m. The patient awoke with a cough, headache, and aching in joints and muscles. He had had a slight cold the preceding three or four days. A severe pneumonia complication appeared November 26, due chiefly to a hemolytic streptococcus. (Chart 25.) The leucocyte count, November 23, was 5,200, polynuclears 69 per cent, lymphocytes 30 per cent, transitionals 1 per cent. A chronic empyema, cavity, with irregular fever, persisting to date, April 7, 1919.

On November 23, 1918, about 31 hours after the onset, this patient furnished secretions from the nasal fossae and posterior nasopharynx, which were used in Experiment No. 4.

R. E. L. (El-1, age 28, U. S. S. *Yacona*).—The onset of illness was Thursday, November 21, at 6 p. m. The initial symptoms were headache, chilliness, pains in back and legs. On November 23 the leucocyte count was 4,000, polynuclears 54 per cent, lymphocytes 43 per cent, transitionals 3 per cent. Recovered, with questionable pneumonic complications. (Chart 26.)

On November 23, 1918, 45 hours after the onset, this patient furnished secretions from the nasal fossae and posterior nasopharynx, which were used in Experiment No. 4.

R. F. J. (Qm-3, age 20, U. S. S. *Yacona*).—The onset of illness was Sunday, November 24, at 6 a. m. The patient felt well Saturday night at 10 p. m. He awoke with chilly sensations, and later in the morning had a severe headache and backache. His throat was a little dry and he coughed considerably. On November 25 the leucocyte count was 5,900, polynuclears 58 per cent, lymphocytes 42 per cent. Recovered, without complications. (Chart 27.)

On November 25, 1918, 31 hours after the onset, this patient furnished secretions from the mouth, nose, pharynx, and bronchi, which were used in Experiment No. 5, and 4 hours later blood, which was used in Experiment No. 6.

R. W. F. (F-2, age 22, U. S. S. *Yacona*).—The onset of illness was Saturday, November 23, at 3 p. m. Symptoms of fever and prostration developed suddenly. The patient complained of no aches, pains, or chills. He had felt well before the onset. Signs of pneumonia developed November 27. On November 25 the leucocyte count was 5,400, polynuclears 84 per cent, lymphocytes 16 per cent. Recovered. (Chart 28.)

On November 25, 1918, 46 hours after the onset, this patient furnished secretions from mouth, nose, pharynx, and bronchi, which were used in Experiment No. 5, and 4 hours later blood, which was used in Experiment No. 6.

S. T. J. (Bm-2, age 23, U. S. S. *Yacona*).—The onset of illness was at 8 a. m., November 21. The patient felt well the night before. The disease began with a severe headache and gastric discomfort. There was no sore throat. On November 23 the leucocyte count was 7,200, polynuclears 58 per cent, lymphocytes 40 per cent, transitionals 1 per cent, basophiles 1 per cent. Recovered, without complication. (Chart 29).

On November 23, 1918, about 55 hours after the onset, this patient furnished secretions from the nasal fossae and posterior nasopharynx, which were used in Experiment No. 4.

W. W. D. (S. A. T. C., age 19).—The onset of illness was Tuesday afternoon, November 13. The initial symptoms were cold in the head and chest, cough, headache, and dizziness, but no backache. Leucocyte count, November 14, was 4,100, polynuclears 79 per cent, lymphocytes 16 per cent, large mononuclears 8 per cent, eosinophiles 2 per cent, mast cells 2 per cent. Sputum examination showed pneumococci and influenza bacilli. Questionable pneumonic complications. Recovered. (C

pproximately 72 hours after onset of illness, secretions furnished
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Y. E. (Cbm., age 27, U. S. S. *Yacona*).—The onset of illness was Monday, November 25, at noon. It started with a headache and a backache. The patient felt warm, his throat was dry, and he had a little cough. He had had no previous sore throat. On November 27 the leucocyte count was 4,800, polynuclears 29 per cent, lymphocytes 59 per cent, transitionals 8 per cent, basophiles 1 per cent, and eosinophiles 3 per cent. Recovery, without complications. (Chart 31.)

On November 26, 1918, about 27 hours after the onset, this patient was used in Experiment No. 7.

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APPENDIX B.

HISTORY OF CULTURES OF PFEIFFER'S BACILLUS USED IN EXPERIMENTS.

(Table III.)

No. 1. McC.—This influenza bacillus was isolated from the lungs at necropsy of one of the cases of the U. S. S. *Yacona*, Tuesday, November 26, 1918, naval hospital, and the culture used in Experiment 8 was the fifth daily transplant. (Chart 32.)

The history of the case indicates a most virulent infection, the disease having lasted only three days. The onset was Saturday morning, November 23. A leucocyte count was not made.

The necropsy showed a coarse, firm, lobular consolidation in both inferior lobes, with beginning larger and more uniformly consolidated areas on both sides, at a site corresponding to the inferior angles of the scapulae.

The cultures from all lobes, except the right middle lobe, which was not involved, gave a predominant staphylococcus aureus, with fairly numerous influenza bacillus colonies.

No. 2. K-OC.—This influenza bacillus was obtained by West tube nasopharyngeal culture, Saturday, November 30. (Chart 33.) The patient was from the U. S. S. *Yacona*, and gave a history of onset of typical influenza November 29 at 8 a. m. He had felt well at 4 a. m. The initial symptoms were severe headache, so that he could hardly see, aching across his hips, and alternate warm and chilly sensations. The light hurt his eyes, and his nose bled slightly. The leucocyte count on the third day was 13,600, polynuclears 78 per cent, lymphocytes 20 per cent, transitionals 2 per cent. Signs of pneumonia developed on the third day. Recovered.

The influenza bacillus obtained by nasopharyngeal culture was transplanted once on whole blood agar and on heated blood agar. Pure cultures were obtained with characteristic morphology and cultural qualities on the two media used. These first transplants were used in Experiment 8.

No. 3. K-CF.—This influenza bacillus was obtained from nasal and posterior nasopharyngeal cultures on blood agar plates, Saturday, November 30. (Chart 34.) The patient was from the U. S. S. *Yacona*, and gave a history of onset of typical influenza Friday, November 29, at 10 a. m. The initial symptoms were headache, backache, photophobia, but no sore throat. The leucocyte count on the third day of the disease was 32,800, polynuclears 87 per cent, lymphocytes 9 per cent, transitionals 4 per cent. Signs of pneumonia developed on this day. Recovered.

The influenza bacillus obtained by culture November 30 was transplanted December 1 on whole blood agar and heated blood agar slants. Pure cultures were obtained with characteristic morphology and cultural qualities. The first transplants were used in Experiment 8.

No. 4. U-W.—This influenza bacillus was obtained from the lungs at necropsy of a case of influenza-pneumonia, Wednesday, November 27. The culture used for inoculation was the fourth transplant.

The history of the case gave an onset of influenza November 12; the patient entered the naval hospital November 19 (Chart 35) with signs of pneumonia. The leucocyte c[illegible]ntrance into the hospital was 15,000. Hemolytic streptococci were obtained [illegible]ema developing late in the pneumonia.

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At necropsy there was a massive broncho-pneumonia, with dilated bronchi and purulent exudate on cut surface. Cultures showed a predominant hemolytic streptococcus, associated with pneumococcus in the right upper lobe, and the influenza bacillus in the left lower lobe.

No. 5. H-E.—This influenza bacillus was obtained from a specimen of washed bronchial sputum, November 19. (Chart 36.) This culture was transplanted every second day on blood agar, so that the culture used in the experiment was about the seventh transplant.

The history of the case shows an onset of influenza November 13. The patient was admitted to the naval hospital November 17 with signs of pneumonia, leucocyte count 4,200. Tenacious, yellowish-white, purulent bronchial sputum was being coughed up. Smears and cultures of this showed numerous influenza bacilli and a few pneumococci. The patient recovered.

No. 6. Youngstown.—This influenza bacillus was obtained at necropsy from the lungs of a patient who died of influenza-pneumonia, about November 20. A subculture was furnished us through the kindness of Dr. G. W. O'Grady.

No. 7. P-BH (123).—This influenza bacillus was obtained from the lungs at necropsy of a case of influenza-pneumonia. The patient had entered the hospital with the history of onset of sickness about a week previously. At that time she had become sick with cough, fever, slight headache and some backache. She had no sore throat. During this time she had been doing her work at intervals. On admission she had signs of pneumonia in her lower right back; in hospital she had a continuous fever of about 101°. After eight days in the hospital, with no alarming symptoms, she suddenly became cyanotic during the night, with difficult respiration, and died within a few hours.

The necropsy findings showed a very discrete broncho-pneumonia in the right lung. The pathological findings hardly explained the sudden death. Cultures from the right lung yielded the influenza bacillus.

The influenza bacillus was obtained from necropsy November 4, 1918, and it was transplanted about every second day. The culture used for inoculation was about the fifteenth transplant on blood agar.

No. 8. Card.—This culture was obtained originally at Walter Reed Hospital about October 15 from post-mortem lung puncture of a case of influenza dying of pneumonia. Pneumococcus, Friedlander bacillus, micrococcus catarrhalis and streptococcus viridans were also obtained. A subculture was furnished by the United States Hygienic Laboratory.

No. 9. Staizecki.—This culture was originally obtained at Walter Reed Hospital about October 15 from post-mortem lung puncture of a case of influenza dying of pneumonia. Pneumococcus and staphylococcus were also obtained. A subculture was furnished by the United States Hygienic Laboratory.

No. 10. Butler.—This culture was originally obtained at Walter Reed Hospital about October 15 from the lung juice of a case of influenza with pneumonia. There were also isolated pneumococcus and staphylococcus. A subculture was furnished by the United States Hygienic Laboratory.

No. 11. CD (112).—No history.

No. 12. CD (157).—No history.

No. 13. Park (105).—Obtained this through the kindness of Dr. W. H. Park.

No. 14. WK.—This influenza bacillus was obtained from washed bronchial sputum of a case of pneumonia, not clearly an influenza-pneumonia. The onset was Thursday, November 7, at 9 a. m. (Chart 37.) The patient suddenly felt weak, his bones ached a little, and he had a severe chill, saying his teeth chattered. He had had a "cold" three or four days previously, his head was stopped up, and he coughed some. Sputum examination showed numerous influenza bacilli and pneumococcus Type I. The clinical course corresponded more to a pneumococcus pneumonia, with crisis following antipneumococcus Type I serum therapy. Recovered.

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APPENDIX C.

ACCOUNT OF THE INFLUENZA EPIDEMIC ON THE U. S. S. YACONA.

In view of the fact that many of the donors from whom material was obtained for our experiments came from the epidemic focus on the U. S. S. *Yacona*, a brief account of the salient features of this outbreak follows. The facts were secured from an epidemiologic report furnished by Dr. E. Calloway, the medical officer on board the U. S. S. *Yacona*.

The U. S. S. *Yacona* is a small gunboat of a convoy unit of the United States Navy. There had been no outbreak of influenza on board previously and the crew had remained intact since the pandemic influenza was recognized.

On September 14, 1918, at the admiralty dockyard, Bermuda, an officer from the U. S. S. *Arctic* reported to the sick bay aboard this vessel and was examined and found to have influenza. The U. S. S. *Chicago*, also in port at this time, had several cases of this disease aboard. The same afternoon the *Yacona* went out to an anchorage and had no other contact until September 16, when she put to sea with the *Chicago* and a convoy of tugs and French submarine chasers.

On September 16 Dr. Calloway had chill and temperature 102°. He remained in the stateroom, seeing only the pharmacist's mate and one mess boy, until September 21, when it became necessary to make medical calls to other vessels. Then, as little contact was allowed as possible, and cases brought aboard were isolated. No cases developed among the *Yacona*'s crew.

On September 27 the vessel arrived in Ponta del Gada, St. Michaels, Azores. Here influenza existed. All men had liberty in this port.

On October 2 the U. S. S. *Chicago*, with tugs and *Yacona*, got under way for Bermuda. Tugs and *Yacona* were inspected and no cases were aboard. U. S. S. *Arctic* had had two cases on previous trips. A few cases were still aboard the *Chicago*. On October 13 we arrived at the admiralty dockyard, Bermuda. Here an epidemic was flourishing. All ships were quarantined, but this was not effective, as men had to use toilets in dockyard while ship was behind breakwater.

On November 1 two cases were admitted with the diagnosis of influenza; both, however, were normal in 24 hours, and this was probably a wrong diagnosis. On November 2, 10 Hospital Corps men from influenza camp were sent aboard for transportation to the United States, as were men from the U. S. S. *Tallahassee* who had recently had the disease.

On November 5 the vessel left St. Georges, Bermuda, and arrived at New York, N.Y., on November 11. All men had liberty in this port. Left New York on the 14th and arrived at New London November 14. Liberty was granted to all men. On November 17 one case was admitted. This man had had liberty at New London. He was transferred to the naval hospital, New London, on November 18. On November 19 one case was admitted and was transferred on the 20th.

On November 20, at 10 p. m., one case was admitted. On November 21, at 6 p. m., under way for Halifax. At 6 p. m. there were nine cases aboard. The medical officer recommended to the commanding officer that the ship put into Boston to transfer cases. We arrived at Boston November 22, at 1 p. m., and transferred cases to the hospital [illegible] below:

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Date.	Men transferred.	Officers transferred.
Nov. 22	14	1
Nov. 23	18	0
Nov. 24	20	3
Nov. 25	15	2
Nov. 26	3	0
Nov. 29	2	0
	72	6

Including the two cases of influenza transferred to the United States naval hospital, New London, Conn., during the epidemic of influenza of this ship, there were 80 cases of influenza in an isolated group of 95 men, or 84.2 per cent. This is a very high incidence of the disease, and indicates a high degree of infectiousness of the causative agent or most favorable condition for the transmission of the infection.

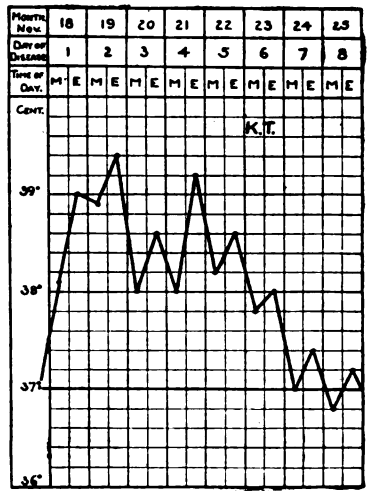

Chart 1.—Temperature curve of Volunteer No. 29 K. T., experiment 2a.

Histories and clinical charts were obtained from each of the 78 cases admitted to the United States naval hospital, Chelsea, Mass. The average maximum temperature for the cases during the first two or three days of the disease was 102.7° F. Twenty of the seventy-eight cases developed bronchopneumonia, one of whom died after only 70 hours of sickness. This case was McCormack, from whom staphylococcus and the influenza bacillus (our culture No. 1) were recovered. The remainder recovered, except one, who developed a hemolytic streptococcus empyema, mentioned on page 26 (O. A.). The incidence of pneumonia in the 78 cases is thus seen to be 25.6 per cent, and the total mortality 1.3 per cent. The low mortality of pneumonia cases, 5 per cent, may perhaps be partly accounted for by the fact that all cases, except the one that died, were treated with convalescent human serum. The average duration of temperature in those cases which did not develop pneumonia was five days.

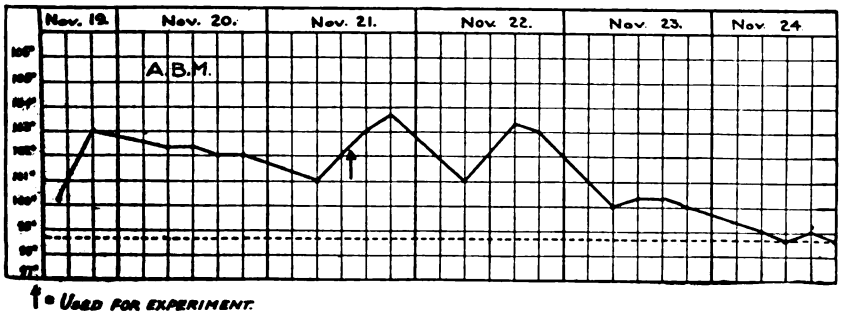

Chart 2.—Temperature curve of donor A. B. M.

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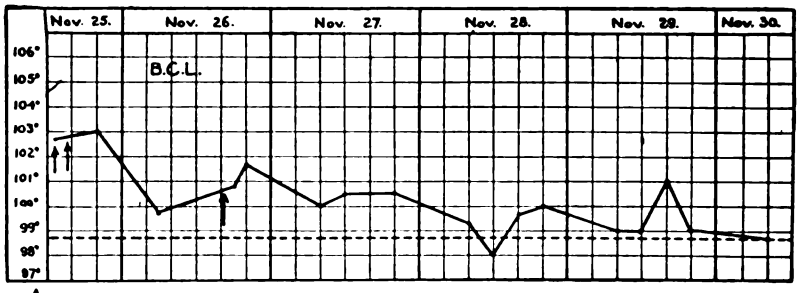

Chart 3.—Temperature chart of donor B. C. L.

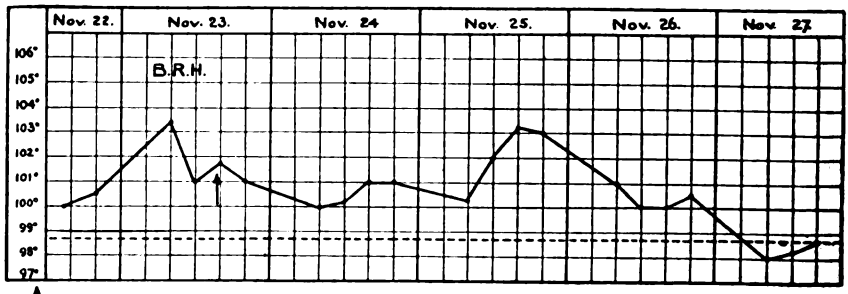

Chart 4.—Temperature curve of donor B. R. H.

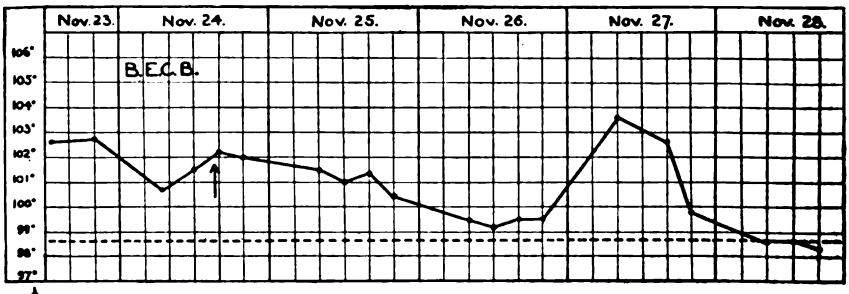

Chart 5.—Temperature chart of donor B. E. C. B.

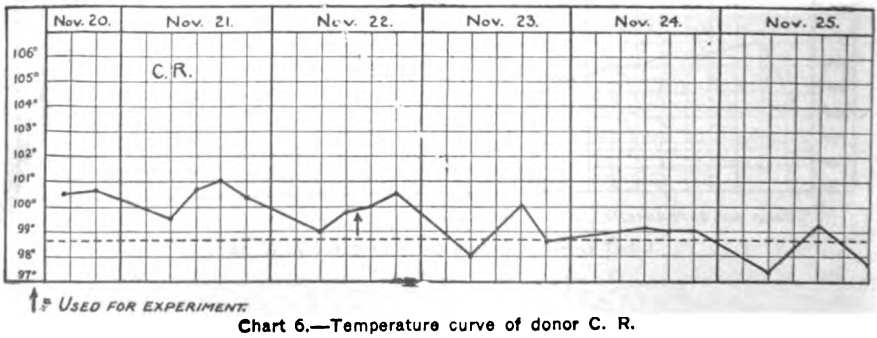

Chart 6.—Temperature curve of donor C. R.

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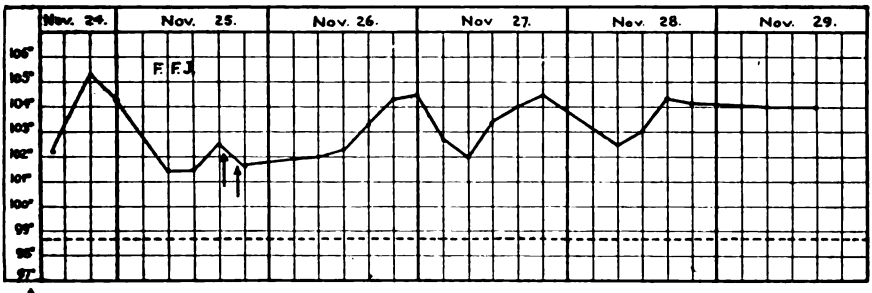

Chart 7.—Temperature curve of donor, F. F. J.

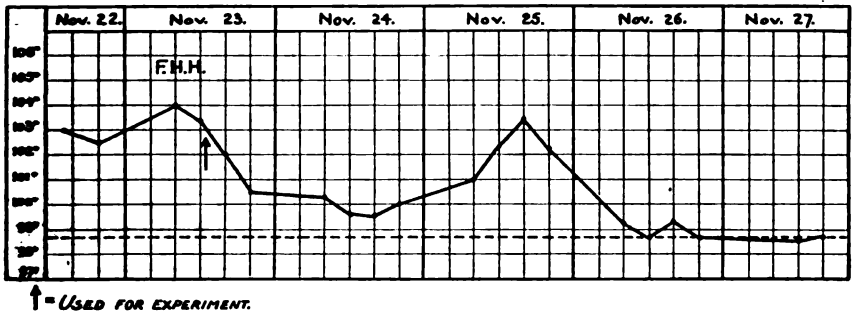

Chart 8.—Temperature curve of donor F. H. H.

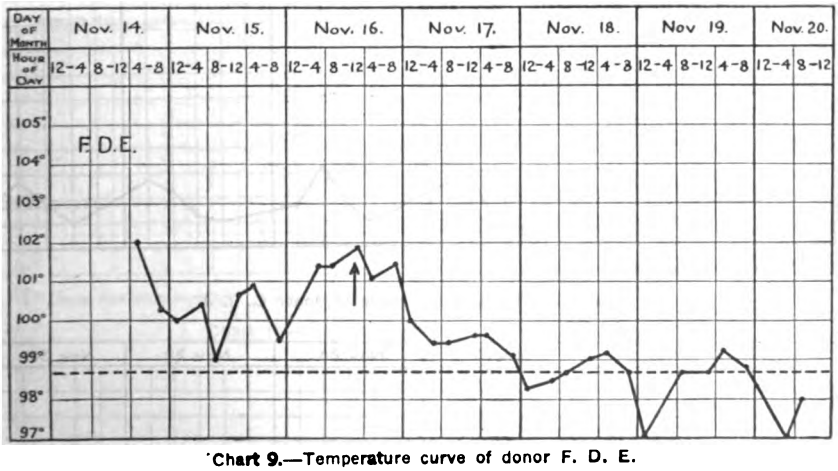

Chart 9.—Temperature curve of donor F. D. E.

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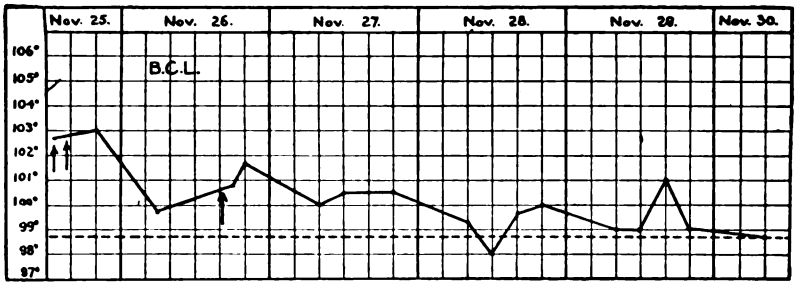

Chart 3.—Temperature chart of donor B. C. L.

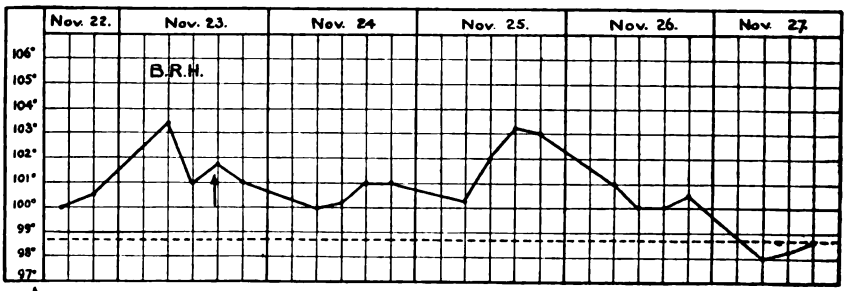

Chart 4.—Temperature curve of donor B. R. H.

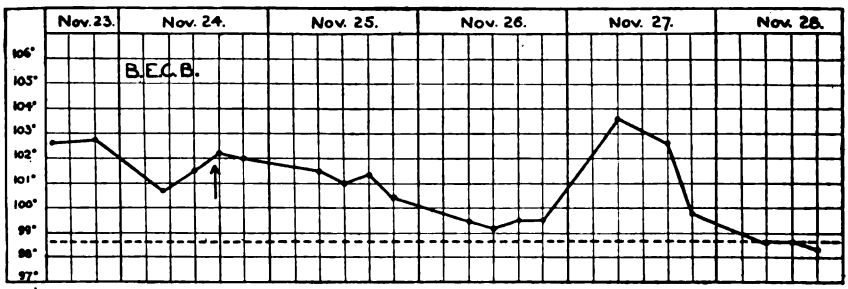

Chart 5.—Temperature chart of donor B. E. C. B.

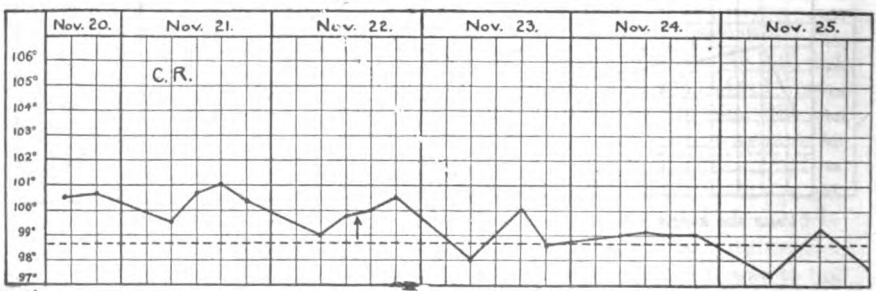

Chart 6.—Temperature curve of donor C. R.

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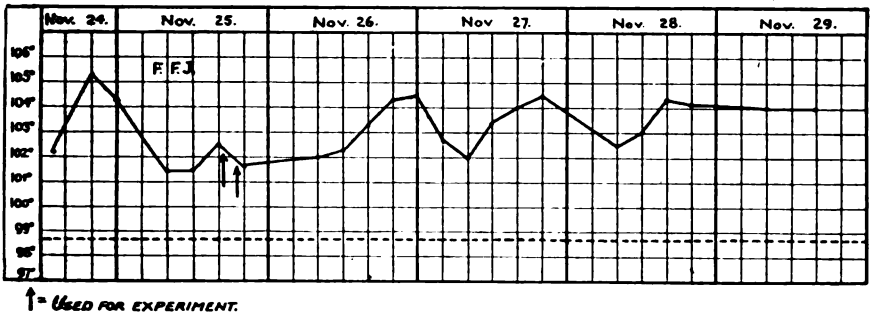

Chart 7.—Temperature curve of donor, F. F. J.

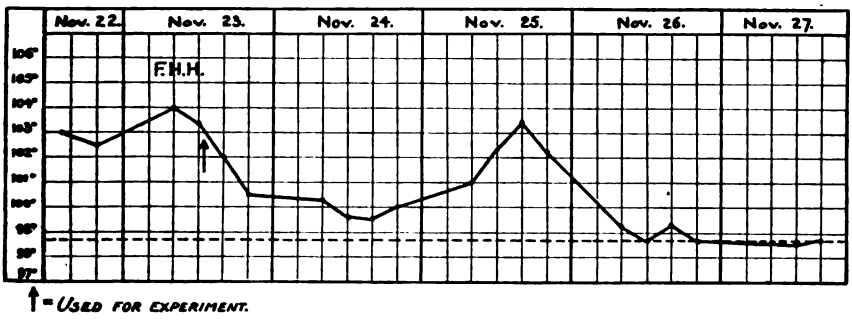

Chart 8.—Temperature curve of donor F. H. H.

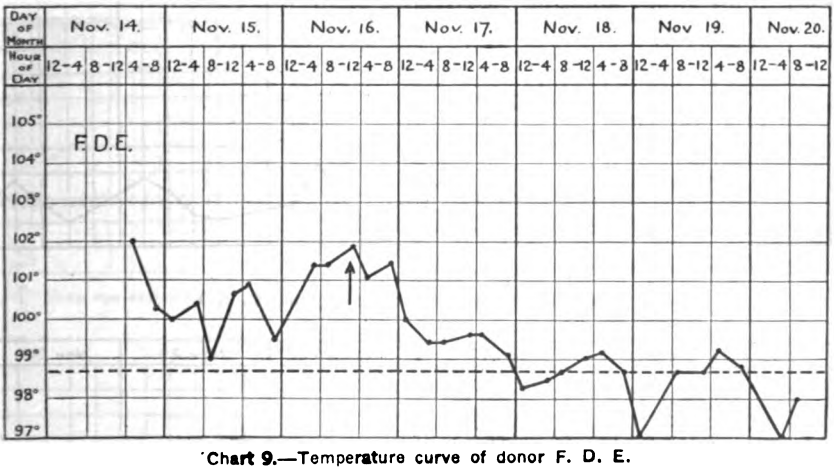

Chart 9.—Temperature curve of donor F. D. E.

181409°—21——3

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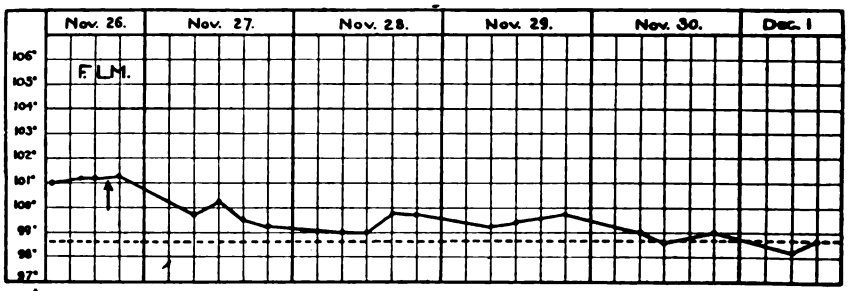
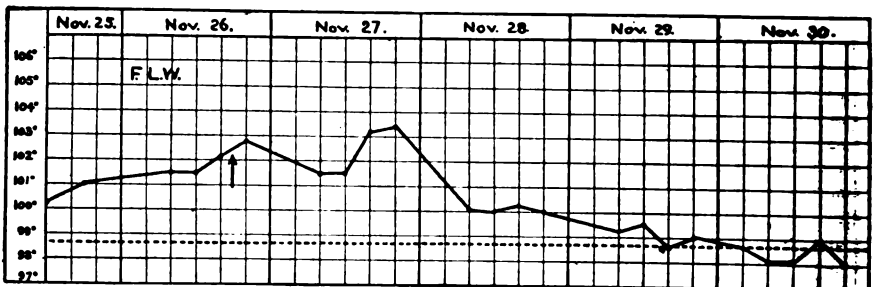


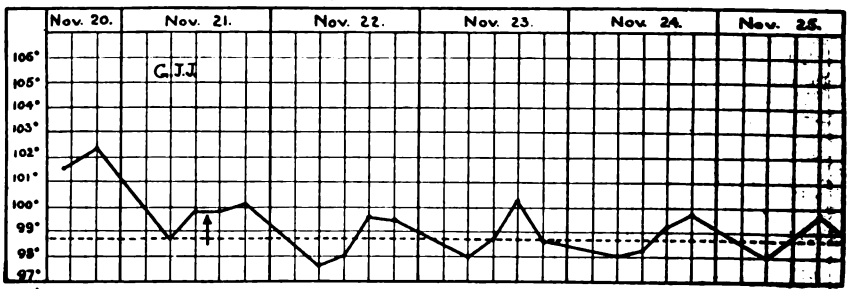
↑ = USED FOR EXPERIMENT.

Chart 10.—Temperature curve of donor F. L. M.



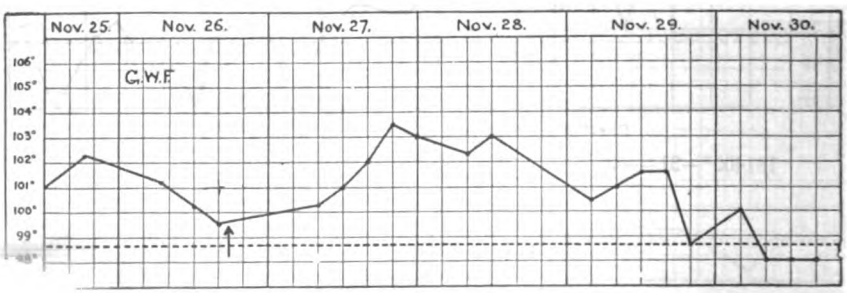
↑ = USED FOR EXPERIMENT.

Chart 11.—Temperature curve of donor F. L. W.



↑ = USED FOR EXPERIMENT.

Chart 12.—Temperature curve of donor G. J. J.



↑ FOR EXPERIMENT.

Chart 13.—Temperature curve of donor G. W. F.

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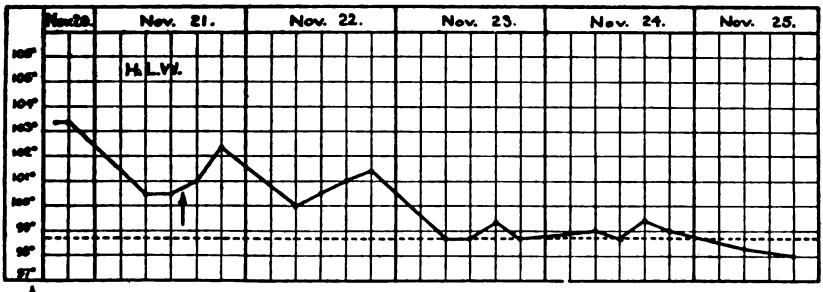
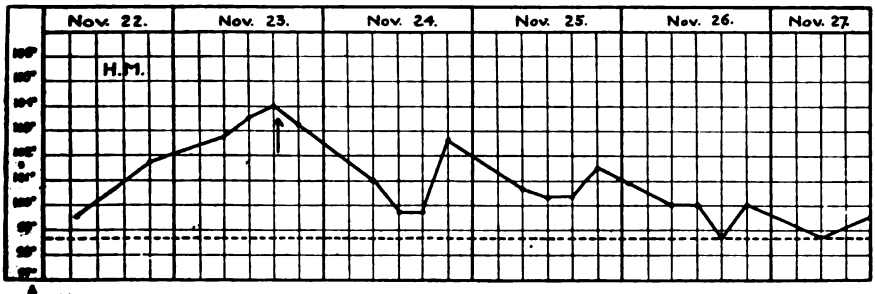


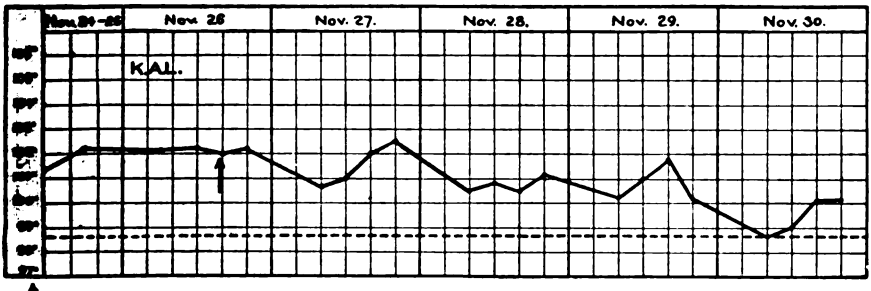
↑= USED FOR EXPERIMENT.

Chart 14.—Temperature curve of donor H. L. W.



↑= USED FOR EXPERIMENT.

Chart 15.—Temperature curve of donor H. M.



↑= USED FOR EXPERIMENT.

Chart 16.—Temperature curve of donor K. A. L.

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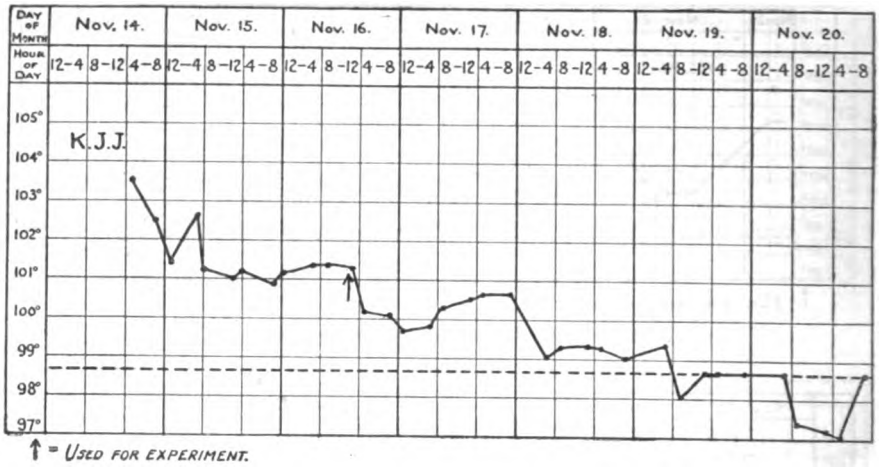

Chart 17.—Temperature curve of donor K. J. J.

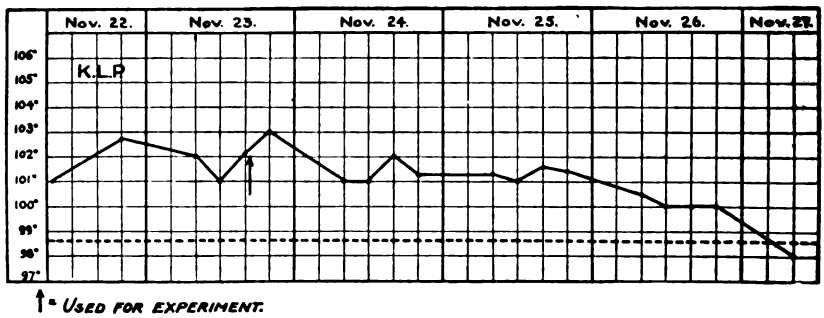

Chart 18.—Temperature curve of donor K. L. P.

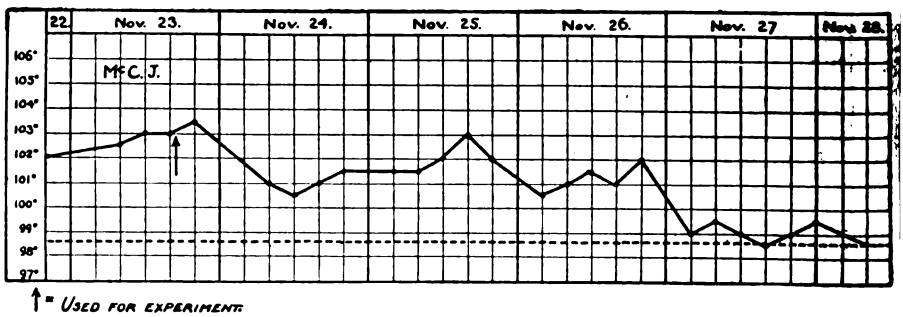

Chart 19.—Temperature curve of donor McC. J.

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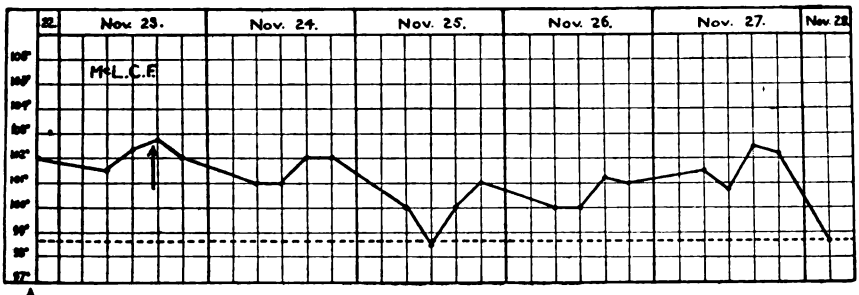
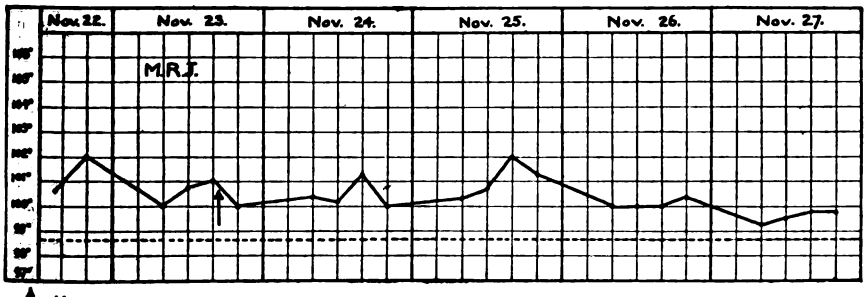


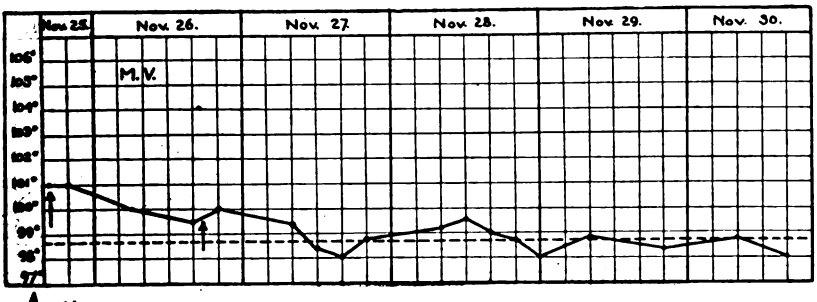
↑= USED FOR EXPERIMENT.

Chart 20.—Temperature curve of donor McL. C. F.



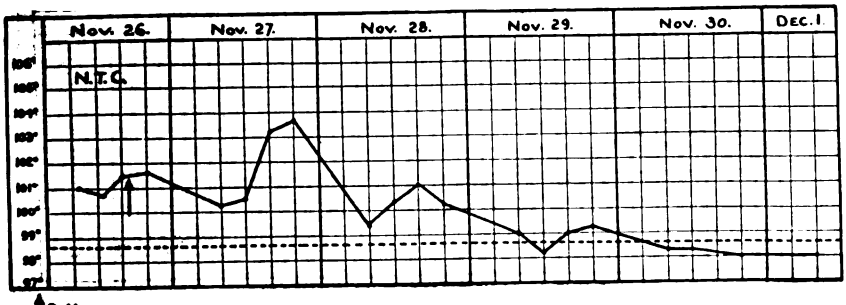
↑= USED FOR EXPERIMENT.

Chart 21.—Temperature curve of donor M. R. J.



↑= USED FOR EXPERIMENT.

Chart 22.—Temperature curve of donor M. V.



↑= USED FOR EXPERIMENT.

Chart 23.—Temperature curve of donor N. T. C.

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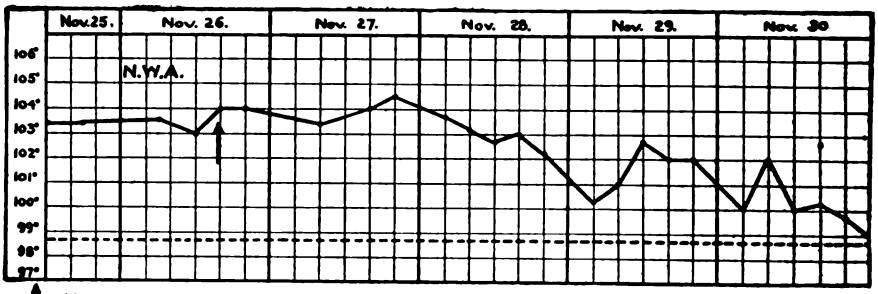

Chart 24.—Temperature curve of donor N. W. A.

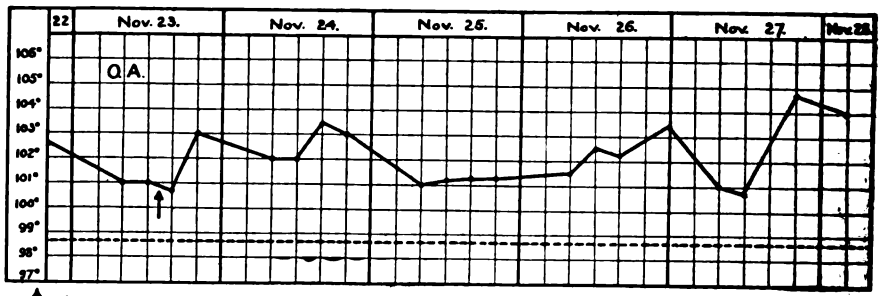

Chart 25.—Temperature curve of donor O. A.

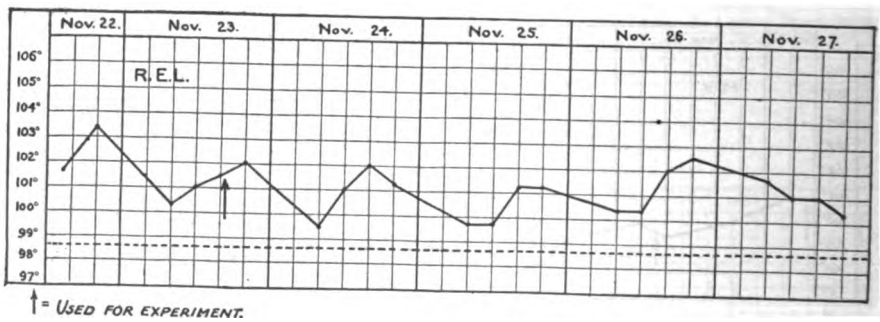

Chart 26.—Temperature curve of donor R. E. L.

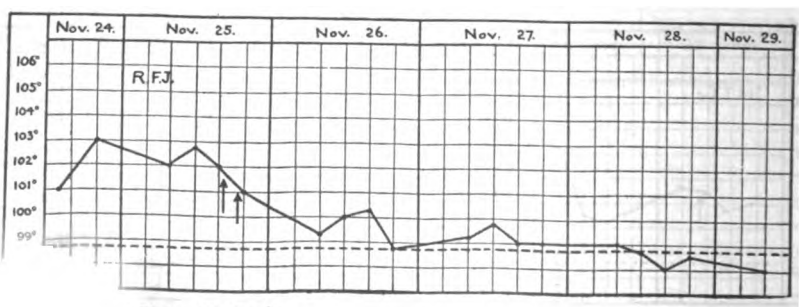

Chart 27.—Temperature curve of donor R. F. J.

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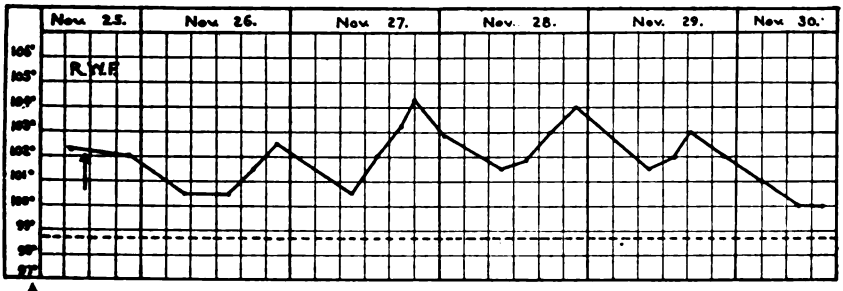

Chart 28.—Temperature curve of donor R. W. F.

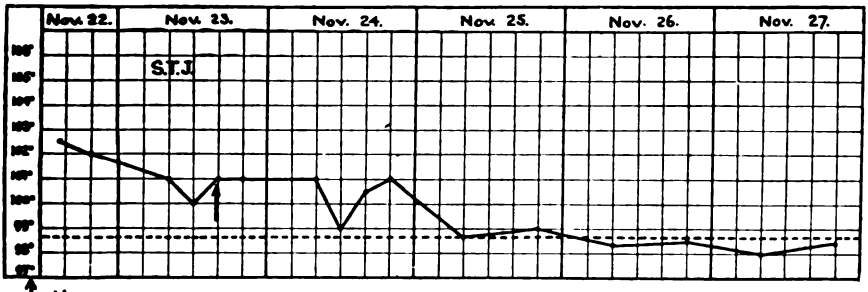

Chart 29.—Temperature curve of donor S. T. J.

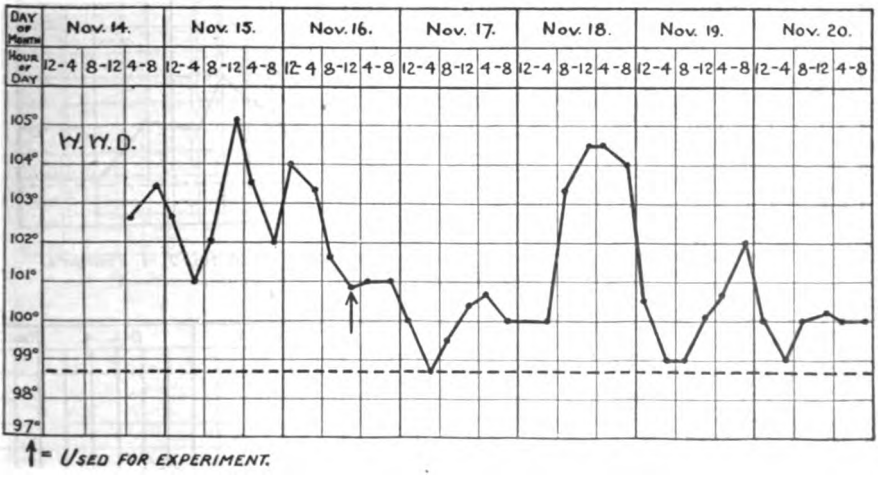

Chart 30.—Temperature curve of donor W. W. D.

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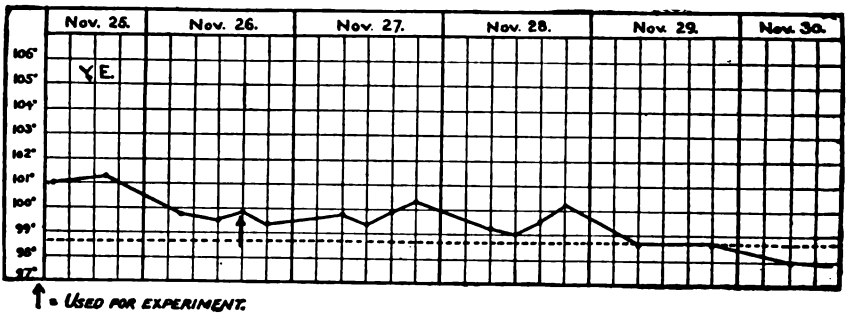


Chart 31.—Temperature curve of donor Y. E.

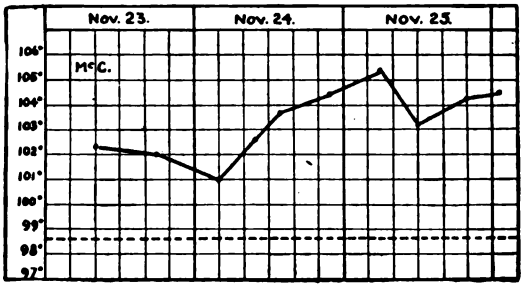


Chart 32.—Temperature curve of case of influenza from which strain No. 1 of Pfeiffer's bacillus was isolated after death.

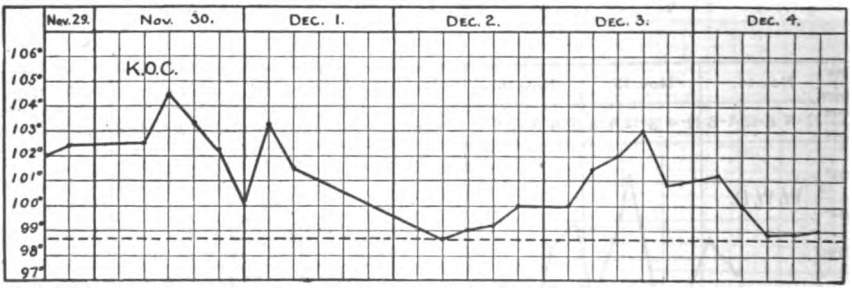
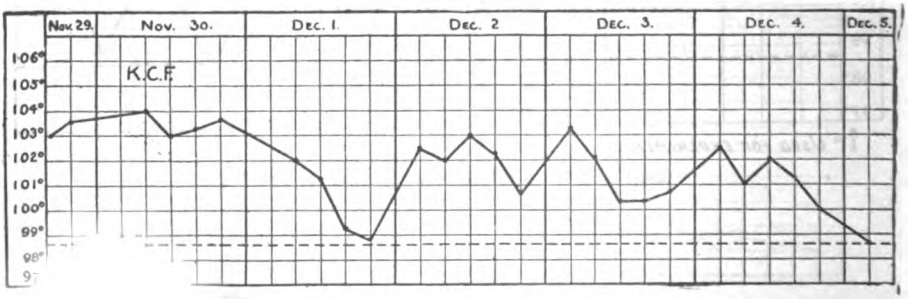


Chart 33.—Temperature chart of case of influenza from which strain No. 2 of Pfeiffer's bacillus was isolated.



rature curve of case of influenza from which strain No. 3 of Pfeiffer's bacillus was isolated.

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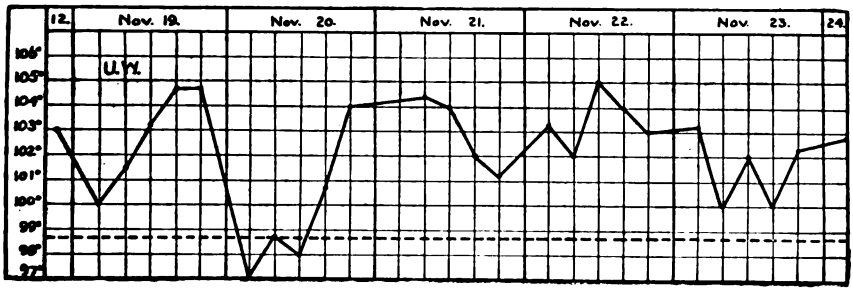

Chart 35.—Temperature curve of case of influenza from which Strain No. 4 of Pfeiffer's bacillus was isolated.

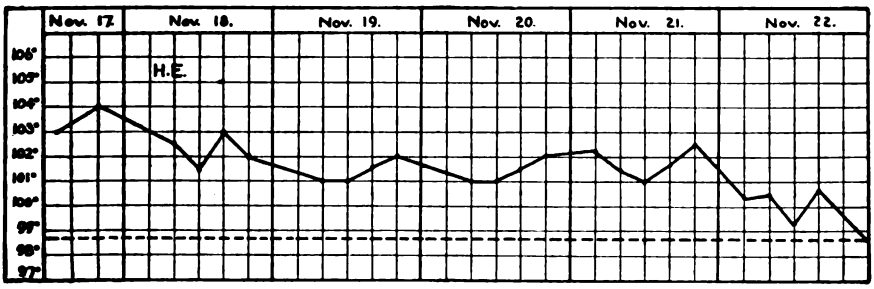

Chart 36.—Temperature curve of case of influenza from which strain No. 5 of Pfeiffer's bacillus was isolated.

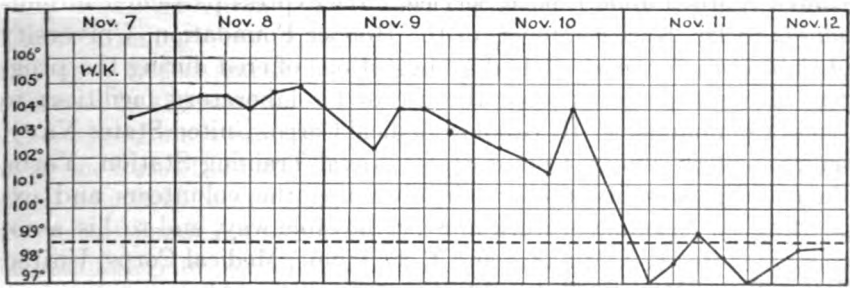

Chart 37.—Temperature curve of case from which strain No. 14 of Pfeiffer's bacillus was isolated.

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II. SERIES OF EXPERIMENTS AT SAN FRANCISCO, NOVEMBER AND DECEMBER, 1918.[1]

By Surg. G. W. McCoy, United States Public Health Service, and Lieut DeWayne Richey, Medical Corps, United States Navy.

The following experiments designed to add to our knowledge of influenza were conducted at the United States Quarantine Station, Angel Island, San Francisco, Calif. Simultaneously, a series of ex-experiments, similar in scope and purpose, were carried on by medical officers who were detailed for the purpose from the United States Navy and the United States Public Health Service, at the United States Quarantine Station, Gallups Island, Boston, Mass.

We take this occasion to extend to those who assisted in this work our sincere thanks. Acknowledgments are due and unreservedly extended to Surg. Gen. W. C. Braisted, United States Navy, and Surg. Gen. Rupert Blue, United States Public Health Service; to the officers of their respective bureaus, especially Rear Admiral E. R. Stitt and Lieut. Commander J. R. Phelps, Medical Corps, United States Navy, and Assistant Surgeon General J. W. Schereschewsky, United States Public Health Service. We express particular indebtedness to Dr. Karl F. Meyer, of the Hooper Foundation, University of California, for many valuable suggestions offered during the progress of the experiments and the use of his laboratory facilities; to Lieut. Commander F. H. Brooks, Medical Corps, United States Navy, senior medical officer, United States Naval Training Station, Yerba Buena, who was instrumental in obtaining the volunteers and expediting the schedule of work in every possible way, and to his associates, Lieuts. A. J. Minaker and R. S. Irvine, Medical Corps, United States Naval Reserve Force, for their valuable assistance in securing clinical, bacteriological, and serological data on the volunteers; to Surgeons W. A. Korn and W. C. Billings, Passed Assistant Surgeon Joseph Bolton, and Assistant Surgeon W. T. Harrison, United States Public Health Service; to Dr. R. G. Broderick and his staff at the San Francisco Hospital, through whose courtesy donors became available to us.

Too much commendation can not be bestowed upon the volunteers, whose unselfish spirit made the experiments possible. The names are given herewith:

[1] Submitted for publication, June, 1919.

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Leggett, James Verna.
Oldham, George W.
Eagan, Estis Theodore.
Harrell, Lewis Roy Kendall.
Toombs, Herbert Edgar Lawrence.
Workman, Lester.
Thomas, Franklyn Forrest.
Bennett, J. C., jr.
Combs, Lester Robert.
Swan, George.
Mulcahey, Daniel Vincent.
Taylor, Christopher Anthony.
Lester, Roy.
Le Duc, Antonio Oliver.
Wages, Verne.
Wall, Lewis Edward.
Lind, Clifford Charles.
Crane, Ellis Madison.
Thompson, Arthur Eugene.
Alsott, Charles Benson.
Lipinski, William.
Tomlins, Roy Lee.
Tegerson, William.
Nardoni, A. M.
Miller, Frank A.
Burton, Clyde.
Dulaney, Floyd Marcue.
Eskew, Herman Virgil.
Hammer, Adolph.
Shankle, John Swanson,
Tharp, Robert Herman.
Autry, Charlie Lester.
Breco, Davis.
Casson, Jesse Meredity.
Fisher, Earl.
McLaughlin, Joseph Francis.
Lorenz, Joshua H.
Hickson, Samuel Dewey.
Morrow, Ernest James.
Stephenson, Neato Augusta.
Hearing, Elvin.
Bertelsen, Hans.
Dickenson, Lester William.
Bennett, Ray Ernest.
Howard, Fred Elmer.
Christian, Lester O.
McGaughy, Oscar A.
Morrison, M. C.
Callison, George A.
Hosey, R. L.

SUBJECTS FOR EXPERIMENTATION.

The 50 individuals upon whom the experiments were conducted, were volunteers from the enlisted personnel at the United States Naval Training Station, Yerba Buena, San Francisco, Calif. They had been under quarantine for a month. At no time had influenza occurred in the station. With 4 exceptions, all of the 50 men had experienced one or more of the exanthemata during childhood. Only 5 of them, Nos. 21, 24, 32, 34, and 36 gave a history of a possible influenzal attack before 1918, and 1, No. 41, said he was stricken during the recent pandemic in October, 1918, by a severe coryza from which he completely recovered. Close interrogation as to the exact nature of this illness failed to reveal probability of influenza. This illness had antedated the subject's admission to the training station by several days.

During the second week in October, 1918, the entire personnel of the station, including the volunteers received a vaccine subcutaneously of which 1 c. c. contained —

B. influenzae	5,000,000,000
Pneumococcus Type I	3,000,000,000
Pneumococcus Type II	3,000,000,000
Pneumococcus Type III	1,000,000,000
Streptococcus haemolyticus	100,000,000

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Three doses were given 48 hours apart. The first consisted of 0.5 c. c. and the remaining two of 1 c. c. each. As a rule the reactions, both local and constitutional, were very slight or were absent.

The physical status of the men was very good. Their ages ranged from 18 to 23. They had all spent the greater portion of their lives west of the Mississippi River. Forty-seven yielded negative Wassermann reactions, the other three being doubtfully positive. Their leucocyte counts varied from 6,800 to 13,400. Only five, Nos. 16, 19, 23, 28, and 37, exceeded 11,500. The differential counts on all but two were within the normal limits. These, Nos. 9 and 26, showed a lymphocytosis. The results of the examination of the volunteers, preliminary to the experiments, are summarized in Table II, page 52.

An attempt to ascertain the nasopharyngeal flora was instituted in all instances before experimentation was entered upon. The swabs were streaked on whole and cooked human blood-agar plates (5 per cent), and, when practicable, a second series of plates was inoculated to insure a wider distribution of the organisms. It was found that *B. influenzae* occurred in about 25 per cent of all cases. A gram-negative diplococcus was encountered in all but two cases (96 per cent). A haemolytic streptococcus was seen in 70 per cent and a streptococcus in 36 per cent. Pneumococci occurred in 78 per cent, while staphylococci, corynebacteria, *Micrococcus tetragenus*, *B. subtilis*, *B. pyocyaneus*, *B. proteus vulgaris*, *B. mesentericus*, and members of the *B. mucosus capsulatus* group were noted occasionally. It is worthy of mention that the flora in the several groups tended to become constant, in that either haemolytic or green producing streptococci or pneumococci would be the predominating organism, according to the group examined.

Inasmuch as a rigid quarantine was being maintained at Yerba Buena, the actual work was conducted at the quarantine station, Angel Island. Here the volunteers were sent in contingents of 10. They were immediately separated into groups of five and assigned to separate quarters.

DESCRIPTION OF EXPERIMENTS.

EXPERIMENT NO. I—NOVEMBER 11, 1918.

Ten men—Nos. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10.

The donor (No. I) was a girl of 9 years. She had been ill 26 hours and was admitted with the history of contact with influenza patients at home. Clinically, the case was typically one of influenza, with an acute onset, a temperature fluctuating from 101° to 103.2° F., pul[illegible]rom 110 to 140, a leucocyte count of 3,800 with 61 per cent [illegible]nuclears, 37 per cent small lymphocytes, and 2 per cent

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large mononuclears. Physical examination of the lungs was negative for pneumonia.

Nasal and pharyngeal swabs and bronchial sputum were introduced into 15 c. c. of sterile plain bouillon. The material was thoroughly shaken and half of it was filtered through a Berkefeld N bougie. Blood-agar cultures of the unfiltered material revealed *B. influenzae*, pneumococci, and staphylococci, while those of the filtrate remained sterile after five days. The secretions were carried to Angel Island, care being taken to keep them warm. The interim between donor and volunteer was 2.5 hours. Three of the men were each given 1 c. c. unfiltered secretions into the nasopharynx, while two were kept as contact controls. Into the nasopharynx of each of three men of a second group was instilled 1 c. c. of the filtrate, the remaining two, being given a few drops of sterile water, were regarded as controls. Instillations into the nares were accomplished by means of a medicine dropper while the subject was reclining, thus permitting the material to flow into the pharynx.

Results.—None of the volunteers experienced any inconvenience from the instillations. The temperatures of all the men remained normal and, after a period of observation of seven days, they were allowed to return to their station.

EXPERIMENT NO. II—NOVEMBER 14, 1918.

Ten men—Nos. 11, 12, 13, 14, 15, 16, 17, 18, 19, and 20.

The material for inoculation was obtained by swabbing the nasopharynx, pharynx, and tonsillar regions of an infant 1 year old (donor No. II) 24 hours after the onset of the illness. The mother and sister, with whom the child had been in contact, were in the hospital with influenza at the time of his admission. The syndrome presented by the child was that of an uncomplicated attack of influenza. The temperature varied from 100° to 102° F.; the pulse was 126, the respiration 24; the leucocyte count 5,800; the differential count showed polymorphonuclears, 69 per cent; small lymphocytes, 24 per cent; large lymphocytes, 5 per cent; and transitionals, 2 per cent. No pulmonary complications could be demonstrated. The swabs were introduced into 15 c. c. sterile plain bouillon and transported to the laboratory, where the material was thoroughly agitated and cultured on whole and cooked human blood agar-agar. Half of the material was drawn through a Berkefeld N candle by a slight amount of negative pressure. The filtration was allowed to take approximately 15 minutes. Cultural controls of the filtrate were sterile, while *B. influenzae*, *Streptococcus haemolyticus*, pneumococcus, and a gram-negative diplococcus were recovered from the unfiltered secretions after portions of the suspensions had been used for the inoculations. Both the raw and filtered secretions were kept warm

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during transportation to Angel Island. The time interval in this instance was 4.5 hours.

The volunteers, having been properly quartered and complying with all the prerequisites, were divided into two groups of five each. Four men of the first group were inoculated with 1 c. c. of the unfiltered nasophargngeal secretions by instillation into the nose with a medicine dropper while in the recumbent position. Into the noses of four men from the second group the same quantity of the filtrate was similarly introduced. One man in each group was allowed to remain uninoculated to serve as contact control.

Results.—In no instance were we able to reproduce the symptom-complex of influenza in those receiving either the unfiltered or the filtered material. One man, No. 11, who received the unfiltered secretions, developed a mild attack of acute lacunar tonsillitis. Upon admission to the quarantine station, Angel Island, it had been noticed that his tonsils were markedly hypertrophic and data were obtained to the effect that he had experienced several similar, though more acute, attacks in recent years. The period between instilling the secretions and the development of symptoms was 50 hours. The temperature was never higher than 100° F., at which time the leucocyte count was 8,880. The pulse fluctuated from 90 to 120 and the respirations were normal. Headache, constipation, and a considerable degree of angina and dysphagia were the chief complaints. Examination of the throat revealed extremely large tonsils, which were of a dusky red color and showed some injection. A few of the crypts contained a small amount of exudate. The temperature reached normal on the fourth day after onset and an uneventful recovery was made. The predominating organism from the cultures of the tonsils was a haemolytic streptococcus of the same type which occurred in the control cultures of the material which the individual received. Although in constant contact, none of the other individuals in this group contracted the disease.

EXPERIMENT NO. III—NOVEMBER 19, 1918.

Ten men—Nos. 21, 22, 23, 24, 25, 26, 27, 28, 29, and 30.

In view of the fact that the early, acute, uncomplicated cases of influenza were not available to us at this time, owing to the decline of the epidemic, the following experiment was performed. The material for nasopharyngeal instillation consisted of a plain bouillon suspension of a 24-hour growth on cooked human blood-agar of eight strains of *B. influenzae.* The cultures were obtained through the courtesy of Dr. Karl F. Meyer of the Hooper Foundation, University of California. The various strains were all isolated from the sputum of [illegible]e early cases of influenza. The exact generation is not [illegible]us, but it was somewhat more distant than the fifth or

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sixth. The suspension was a very heavy one. A portion of it was filtered through a Berkefeld N candle. Cultures of the filtrate were negative. The material was carried, at body temperature, to the place of experimentation. The upper respiratory passages of four men of the first group were thoroughly sprayed with the suspension of living *B. influenzae*, while the fifth man was kept as a control. The warm filtrate was introduced in the same manner into the nasopharynges of four men from the second group, there being one control individual for this group. Following the instillation, the unfiltered suspension was taken back to the laboratory, where control cultures yielded an abundant growth of *B. influenzae* in 18 hours. The time interval between the filtration of the suspension and the inoculation of the volunteers was two hours.

The nasopharyngeal cultures, taken before the experiment, of the men who received the suspension of living organisms, failed to show the presence of organisms suggesting Pfeiffer's bacillus. In a second series of cultures, taken from the same individuals three days after the instilling of the living organisms, and spread on uncooked and cooked human blood agar (5 per cent) plates, it was possible to recover the organism in all cases. Cultures from the nasopharynx of the contact control of this group, in which no *B. influenzae* had been found, continued to show an absence of these organisms.

Results.—All of the members of this group remained, apparently, perfectly well, and at the end of seven days were permitted to return to their station.

EXPERIMENT NO. IV—NOVEMBER 22, 1918.

Ten men—Nos. 31, 32, 33, 34, 35, 36, 37, 38, 39, and 40.

The donor (No. III) for this experiment was a hospital apprentice, aged 22, who had received the three doses of vaccine at Yerba Buena in October. He was taken suddenly ill, after shaving several influenzal patients a day or so previously. The onset was characterized by headache, backache, chills, epistaxis, and photophobia, and had occurred 48 hours previously. The throat was not sore and examination showed the tonsils to be apparently free from any inflammatory involvement. The posterior pharyngeal wall was injected. The chest findings were negative. The temperature ranged from 100 to 102.3° F.; the pulse from 100 to 116; the respirations from 22 to 24. The leucocyte count was 18,500 on one occasion and 19,200 the following day. The differential count revealed 85 per cent polymorphonuclears, 11 per cent small lymphocytes, 3 per cent large mononuclears, and 1 per cent esoinophiles. The urinalysis showed no albumin. The Wassermann reaction and a blood culture were negative.

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Forty-eight hours after the onset of the initial symptoms, the patient's upper respiratory passages were thoroughly washed with sterile physiological salt solution. The nasopharynx, pharynx, and tonsillar regions were swabbed, the swabs washed off with the saline solution, and to this was added some freshly expectorated bronchial sputum. The entire bulk was made up to 100 c. c. with additional physiologic salt solution, thoroughly emulsified, and a portion passed through a Berkefeld N candle, with the aid of a vacuum pump. Cultural controls of the unfiltered secretions made before the inoculations of the volunteers showed *Streptococcus haemolyticus*, a green producing streptococcus, a gram-negative diplococcus, and diphtheroids. Cultures from the filtrate showed no growth.

The unfiltered and filtered secretions were taken to Angel Island, and, after an interval of 4.5 hours from the time they had been recovered from the donor, each was sprayed into the nasopharynges of four volunteers. The remaining two men of this group were, as before, kept with their respective sections as contact controls.

Results.—None of the men who received the filtrate presented any untoward symptoms, all remaining quite well during the following week.

Of those who received the unfiltered secretions, two men, Nos. 31 and 32, became ill with a severe attack of acute lacunar tonsillitis. Within 36 hours after the inoculation into the nasopharynx, both complained of headache, malaise, some nausea, chilly sensations, and sore throat. Their temperatures abruptly rose to 103 and 100.2° F., respectively, reaching the fastigium within 72 hours. The pulse ranged from 100 to 120. The leucocyte counts were 18,000 and 14,000, respectively. Examination of the tonsils showed the crypts to be filled with a creamy, yellowish, purulent exudate. The tonsils were swollen and markedly congested. Prostration was not marked and at no time could any abnormal findings be made out over the lung areas. Bacteriological examination of the tonsillar exudate from both cases yielded an apparently pure culture of the same type of haemolytic streptococcus as was encountered in the control cultures of the donor's unfiltered secretions. There was no reason for believing that these were attacks of influenza. Their temperatures reached normal on the fourth day. The other members of the group failed to contract the disease, despite the fact that they were in constant association with the affected volunteers.

EXPERIMENT NO. V.—DECEMBER 2, 1918.

Four men—Nos. 41, 42, 43, and 44.

The donor (No. IV) was a nurse 21 years of age. She had become ill 12 h[illegible] before the diagnosis was established and the secretions obt[illegible] onset was sudden and characterized by headache, ve[illegible] a cough. The temperature at the time was 101.2°

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F., the pulse 104, and respiration 24. The white blood cell count was 8,100, of which 57 per cent were polymorphonuclears, 29 per cent were small lymphocytes, 7 per cent were large mononuclears, 5 per cent transitionals, and 2 per cent eosinophiles. The urinalysis and Wassermann reaction were negative.

Twenty c. c. of sterile, normal saline solution were employed to wash the upper respiratory passages and with this was incorporated the material from nasopharyngeal swabs, as well as freshly expectorated sputum. The entire collections were diluted to 100 c. c. with additional sterile normal saline solution, and after the usual bacteriological controls, a portion was filtered through a Berkefeld N bougie. The filtration consumed about five minutes being facilitated by the negative pressure of a vacuum pump. Cultures from the filtrate showed no growth upon repeated examinations; while those of the unfiltered secretions yielded *B. influenzae*, haemolytic streptococcus, pneumococci, and a gram-negative diplococcus.

The material was collected at 1 p. m. and the filtrate was sprayed into the nasopharynges of two volunteers, Nos. 41 and 42, at 6.30 p. m., an interval of 5.5 hours. At the same time two men, Nos. 43 and 44, received the same amount, about 3 c. c., of the unfiltered nasal washings. Two other men, Nos. 49 and 50, were not utilized, but were kept segregated as available controls in the event that any of the individuals in this or subsequent experiments contracted any illness.

Results.—All of the four individuals remained very well, and at the end of a week were discharged.

EXPERIMENT NO. VI.—DECEMBER 2, 1918

Two men—Nos. 45 and 46.

The object of this experiment was an attempt to reproduce influenza by instillation into the conjunctival sac.

The material was from the donor (No. IV) employed in the previous experiment. Only the filtrate was used.

Into both conjunctival sacs of the two men at least 1 c. c. of the filtrate was instilled with a medicine dropper and 1 c. c. sprayed by an atomizer. This occurred 6 hours after the material was secured.

Results.—Neither individual showed any indication of illness during the seven days of observation.

EXPERIMENT NO. VII.—DECEMBER 2, 1918.

One man—No. 47.

In this experiment an endeavor was made to transmit influenza by means of subcutaneous injection of the filtrate of the nasopharyngeal and bronchial secretion from a patient ill with the disease.

The material was from the same lot utilized in Experiments V and VI.

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Two c. c. of the filtrate were injected, subcutaneously, into the deltoid region of the left arm. As was the routine in all the experiments, the volunteer was isolated from any other individuals, or groups of individuals.

Results.—The effect of the injection was negative, not even a local reaction being noted.

EXPERIMENT NO. VIII—DECEMBER 3, 1918.

One man—No. 48.

This experiment was undertaken to ascertain the effect of subcutaneous injection of whole blood, from a patient ill of influenza.

The donor (No. V) was a nurse 27 years of age. The onset of her illness preceded the withdrawal of the blood by 24 hours, and was attended by intense coryza, headache, general aching, languor, and malaise. The temperature varied from 101.6 to 103.5° F.; the pulse from 100 to 120. The leucocyte count was 10,400, of which 84 per cent were polymorphonuclears, 9 per cent were small lymphocytes, 5 per cent were large lymphocytes, and 2 per cent were eosinophiles. The Wassermann reaction, blood culture, and urinalysis were negative.

Three days after furnishing the blood the patient developed a broncho-pneumonia, from which she recovered.

Ten c. c. of blood were removed from the left median cephalic vein and mixed with an equal amount of sterile 1 per cent sodium citrate solution.

The blood was immediately taken to Angel Island, where, within 1.5 hours, 2.5 c. c. of it were injected into the subcutaneous tissue of the left deltoid region.

Results.—The volunteer remained healthy during the week following the injection and was permitted to return to his station.

SUMMARY.

Thirteen volunteers received the filtrate of nasopharyngeal secretions into their upper respiratory passages, while 13 were given the unfiltered secretions after a similar fashion. Ten men were used as contact controls. Some of a filtrate was inoculated into the conjunctival sacs of two and injected subcutaneously into a third. Whole blood was administered under the skin of one individual.

Four men were given a pooled suspension of eight living strains of *B. influenzae* into their nasopharynges and four were given the filtrate of the same suspension.

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Care was taken to control every step and it is to be regretted that the time interval between donors and volunteers, which varied from two to six hours, could not, under the circumstances, be shortened.

Control cultures of the unfiltered secretions yielded a high percentage of *B. influenzae*, hemolytic streptococci, pneumococci, and Gram-negative diplococci. Cultures of the filtrates were invariably sterile.

In no instance was a clinical case of influenza produced.

Three of the volunteers who received unfiltered nasopharyngeal secretions became ill with acute lacunar tonsillitis.

TABLE I.—*Donors, San Francisco experiments.*

No.	Age.	Sex.	Occupation.	Onset.	Temperature range.	Pulse.	White count.
I	9	Female....	Child.....	Sudden.....	101 –103.2	110–140	3,800
II	1	Male.....	Infant.....	.....do.....	100 –102	126	5,800
III	22	...do.....	Hospital apprentice.....	.....do.....	100 –102.3	100–116	18,500
IV	21	Female....	Nurse.....	.....do.....	101.2–104	104–127	8,100
V	27	...do.....	.....do.....	.....do.....	101.6–103.5	100–120	10,400

No.	Age.	Sex.	Complications.	Time between onset and collection of material.	History of contact.	Bacteriology of nasopharyngeal washings.
I	9	Female....	None; recovery.....	26 hours.....	Yes.....	*B. influenzae*, pneumococci, staphylococci.
II	1	Male.....	.....do.....	24 hours.....	...do.....	Gram-negative diplococcus, *B. influenzae*, pneumococci, *streptococcus hemolyticus*,
III	22	...do.....	.....do.....	48 hours.....	...do.....	*Streptococcus hemolyticus*, green producing streptococcus, gram-negative diplococcus, diphtheroids.
IV	21	Female....	.....do.....	12 hours.....	...do.....	*B. influenzae*, *streptococcus hemolyticus*, pneumococci, gram-negative diplococcus.
V	27	...do.....	Post-influenzal broncho-pneumonia; recovery.	24 hours.....	...do.....	Secretions not furnished. Supplied blood for subcutaneous inoculation.

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TABLE II.—*Volunteers, San Francisco experiments.*

No.	Age.	State.	Doses of vaccine.	Previous attacks possibly influenza.	Wassermann.	White count.	Polymorphonuclears.	Small lymphocytes.	Large lymphocytes.	Large mononuclears.	Transitionals.	Eosinophiles.	Basophiles.
1	21	Oklahoma	3		Negative	8,800	66	21	7	4	1	1	0
2	18	do	3		do	9,200	67	25	3	1	4	0	0
3	22	Missouri	3		do	8,200	65	26	5	2	2	0	0
4	19	Texas	3		do	9,000	59	36	0	5	0	0	0
5	20	do	3		do	9,000	48	34	7	0	2	9	0
6	18	Oklahoma	3		do	9,400	56	34	4	2	4	0	0
7	23	do	3		do	8,800	57	35	6	1	0	1	0
8	18	Texas	3		do	9,600	71	21	4	1	3	0	0
9	18	Oklahoma	3		do	7,900	52	43	2	1	2	0	0
10	19	do	3		do	9,400	60	28	7	1	0	4	0
11	19	do	3		do	7,200	58	35	5	1	1	0	0
12	21	do	3		do	10,200	62	27	2	2	5	1	1
13	21	Texas	3		do	6,900	71	20	5	3	1	0	0
14	19	Oklahoma	3		do	8,200	51	35	9	2	1	2	0
15	19	do	3		do	10,250	60	24	9	4	3	0	0
16	19	do	3		Positive (††)	13,400	77	16	4	1	2	0	0
17	18	do	3		Negative	7,600	62	28	7	1	2	0	0
18	19	do	3		do	10,300	62	24	10	3	1	0	0
19	21	do	3		do	11,850	69	21	6	3	0	1	0
20	21	do	3		do	10,300	65	24	5	3	2	0	1
21	19	Nebraska	3	[1] 1	do	10,600	75	15	7	1	2	0	0
22	19	do	3		do	9,800	65	23	6	3	1	1	1
23	22	Oklahoma	3		do	13,350	66	21	8	4	0	1	0
24	18	Iowa	3	[1] 1	do	10,000	70	20	3	4	1	1	1
25	18	Utah	3		Positive (†)	11,500	58	22	11	5	1	2	1
26	18	Mississippi	3		Negative	7,800	35	48	10	4	1	0	2
27	22	Utah	3		do	7,300	67	24	4	4	0	1	0
28	19	Oklahoma	3		do	12,000	60	25	7	5	1	2	0
29	19	Arkansas	3		do	9,500	67	22	5	3	2	0	1
30	20	Michigan	3		do	11,500	57	23	10	6	3	1	0
31	18	Washington	3		do	8,800	64	24	7	1	4	0	0
32	18	California	3	[2] 1	Positive (†)	10,700	65	20	8	5	1	1	0
33	19	Minnesota	3		Negative	8,000	66	24	8	1	0	1	0
34	22	Oregon	3	[2] 1	do	7,200	61	30	7	2	0	0	0
35	19	Washington	3		do	8,400	55	30	14	0	0	0	1
36	21	Idaho	3	[1] 1	do	7,800	66	18	12	3	1	0	0
37	19	California	3		do	11,800	70	20	6	1	1	2	0
38	18	Oklahoma	3		do	7,300	70	22	6	1	0	1	0
39	18	Colorado	3		do	8,400	70	20	6	3	1	0	0
40	18	do	3		do	8,200	64	25	9	1	1	0	0
41	19	California	3	[3] 1	do	7,400	72	23	2	0	3	0	0
42	21	Colorado	3		do	9,300	69	26	3	0	1	1	0
43	18	Minnesota	3		do	8,800	70	26	1	0	1	0	2
44	20	Oklahoma	3		do	7,300	74	25	3	0	2	0	0
45	21	Missouri	3		do	7,100	75	20	4	1	0	0	0
46	19	Colorado	3		do	8,100	68	27	2	0	2	1	0
47	20	California	3		do	8,400	69	25	4	0	1	1	0
48	20	Oklahoma	3		do	9,100	64	31	2	0	1	1	1
49	18	do	3		do	6,800	77	18	3	0	2	0	0
50	21	do	3		do	9,000	72	24	3	0	0	1	0

[1] 1916. [2] 1917. [3] 1918.

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TABLE III.—*San Francisco experiments.*

No.	Material.	Site or mode of inoculation.	Date.	Result.
1	Unfiltered nasopharyngeal washings	Nasopharynx	Nov. 11, 1918	Negative.
2	do	do	do	Do.
3	do	do	do	Do.
4	None (contact control)		do	Do.
5	do		do	Do.
6	Filtrate of nasopharyngeal washings	Nasopharynx	do	Do.
7	do	do	do	Do.
8	do	do	do	Do.
9	None (contact control)		do	Do.
10	do		do	Do.
11	Unfiltered nasopharyngeal washings	Nasopharynx	Nov. 14, 1918	Acute lacunar tonsilitis.
12	do	do	do	Negative.
13	do	do	do	Do.
14	do	do	do	Do.
15	None (contact control)		do	Do.
16	Filtrate of nasopharyngeal washings	do	do	Do.
17	do	do	do	Do.
18	do	do	do	Do.
19	do	do	do	Do.
20	None (contact control)		do	Do.
21	Unfiltered suspension (*B. influenzae*)	do	Nov. 19, 1918	Do.
22	do	do	do	Do.
23	do	do	do	Do.
24	do	do	do	Do.
25	None (contact control)		do	Do.
26	Filtrate of suspension (*B. influenzae*)	Nasopharynx	do	Do.
27	do	do	do	Do.
28	do	do	do	Do.
29	do	do	do	Do.
30	None (contact control)		do	Do.
31	Unfiltered nasopharyngeal washings	Nasopharynx	Nov. 22, 1918	Acute lacunar tonsilitis.
32	do	do	do	Do.
33	do	do	do	Negative.
34	do	do	do	Do.
35	None (contact control)		do	Do.
36	Filtrate of nasopharyngeal washings	Nasopharynx	do	Do.
37	do	do	do	Do.
38	do	do	do	Do.
39	do	do	do	Do.
40	None (contact control)		do	Do.
41	Filtrate of nasopharyngeal washings	Nasopharynx	Dec. 2, 1918	Do.
42	do	do	do	Do.
43	Unfiltered nasopharyngeal washings	do	do	Do.
44	do	do	do	Do.
45	Filtrate of nasopharyngeal washings	Conjunctiva	do	Do.
46	do	do	do	Do.
47	do	Subcutaneous	do	Do.
48	Whole, citrated, human blood	do	Dec. 3, 1918	Do.
49	None			Do.
50	do			Do.

In considering the results of these experiments, which, to our surprise, resulted uniformly negatively so far as transmission of influenza is concerned, it must be borne in mind that we were so situated that a considerable time always elapsed between the taking of the material from the donor and its application to the recipient. This interval may be sufficient to account for the negative results secured.

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III. SERIES OF EXPERIMENTS AT BOSTON, FEBRUARY AND MARCH, 1919.[1]

By Lieut. Commander M. J. Rosenau, Lieut. W. J. Keegan, and Lieut. De Wayne Richey, United States Navy; and Surg. Joseph Goldberger, Surg. G. W. McCoy, Passed Asst. Surg. J. P. Leake, and Passed Asst. Surg. G. C. Lake, United States Public Health Service.

GENERAL CONSIDERATIONS.

These experiments were conducted at the United States Quarantine Station, Gallups Island, Boston, Mass., upon volunteers from the United States Naval Detention Training Camp, Deer Island, Mass., by medical officers detailed for the purpose from the United States Public Health Service and United States Navy. They can be regarded as a continuation of the previous series of experiments at the same place under the auspices of the same services and with the same objects, to ascertain the cause and mode of spread of influenza

Cooperation and assistance, without which these experiments could not have gone forward, were received from Surg. Gen. W. C. Braisted, United States Navy; Surg. Gen. Rupert Blue, United States Public Health Service; Rear Admiral E. R. Stitt, and Commander J. R. Phelps, Medical Corps, United States Navy; Asst. Surg. Gens. J. W. Schereschewsky and R. H. Creel, United States Public Health Service; Capt. John M. Edgar, Commander F. M. Furlong, Lieut. Commander L. W. McGuire, Lieut. W. R. Redden, Lieut. A. L. Grant, Lieut. J. W. Parsons, and Lieut. T. J. Kennedy, Medical Corps, United States Navy; Lieut. J. W. Flannery and Chaplain J. M. J. Quinn, of the Deer Island Training Station, United States Navy; Surg. W. M. Bryan, Act. Asst. Surgs. F. X. Crawford and E. M. Looney, United States Public Health Service; Dr. Harry Linenthal, Prof. Reid Hunt, and Prof. Worth Hale, of the Harvard Medical School; and the donors and recipients of the experimental material. The volunteers particularly deserve credit; their names are given in Table I.

Time.—The experiments began with the advent of the volunteers to the island on February 4–6, 1919, and were concluded March 10, 1919.

Place.—Gallups Island is a small island of about 16 acres, lying 6 miles down Boston Harbor. It is one-fourth mile from the nearest land [illegible] Fort Standish, on Lovells Island. Its topography is

[1] [illegible]tion July, 1919.

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hilly; the hygienic conditions are very good and its buildings, about 30 in number, including quarters, barracks, mess halls, galleys and hospitals, are equipped with modern heating, lighting and sanitation facilities.

Climatic conditions.—Gallups Island shared in the unusually mild winter of the Atlantic seaboard. During the time the experiments were in progress the maximum temperature was 50° F., and the minimum 18° F., with a mean temperature of from 38° to 43° F. As a rule the days were clear, and plenty of sunshine prevailed. There was always a brisk breeze which sometimes became accelerated to a gale of about 40 miles per hour. Occasionally it rained and less frequently snow fell. No one, at any time, experienced any inconvenience, much less hardship, from the weather during the sojourn on this station.

Volunteers.—The entire contingent consisted of 49 men, 30 of whom arrived on February 4, 1919, and 19 on February 6, 1919. Of these, 6 did not come under experimentation, leaving 43 on whom 82 inoculations were made. These are accounted for as follows: 1 man received 3 inoculations, 37 received 2, and 5 received 1.

The men were from 19 to 36 years of age. Two were nineteen; 30 were from 20 to 25; 9 were from 26 to 30; and 2 were 33 and 36, respectively.

Physically, the men were in very good condition. Eleven showed rather large tonsils, with some congestion of the pharynx. The weights ranged from 125 to 182 pounds. The mean weight on admission was 157 pounds, and on discharge 157.6 pounds. Sixteen men gained from 1 to 12 pounds, 15 lost from 1 to 12 pounds, and the weight of 12 remained stationary.

The leucocyte counts varied from 5,600 to 11,200. Care was taken to obtain all blood counts at approximately 1 hour before mealtime.

At Deer Island, from which place the volunteers came, cases of influenza since January 1, 1919, are recorded as follows:

January 2	1	January 24	1
January 3	1	January 25	1
January 4	1	January 27	1
January 6	1	January 29	1
January 8	1	January 30	1
January 11	1	January 31	1
January 18	1	February 3	2
January 20	1	February 4	1

A careful history was taken of each man prior to the beginning of actual experimentation. Stress was laid upon data pertinent to previous health, and, more especially, upon their activities and ailments during the recent pandemic of influenza. It was found that

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the men had always enjoyed very good health, some of them having never been ill, to their knowledge, in their lives. As to contact with influenza patients since the early autumn, 18 men (42 per cent) had not been exposed; 12 men (28 per cent) had experienced the casual contact of the ordinary walks of life, while 11 men (26 per cent) had had close contact with patients ill with influenza. Volunteer No. 24 gave a history of an attack of influenza while at Deer Island in September, 1918. Another, No. 40, probably had an attack while at Portsmouth, N. H., in October, 1918.

The names, numbers, and ages of the men, with their history as regards exposure to influenza and the result of examination for susceptibility to diphtheria by the Schick test, are given in Table I.

During the first week of their sojourn on the island, the men were quartered in large barracks, ate at the same mess and were allowed to congregate at will. They entered into out-of-doors sports and did light chores about the station. For five days before the first experiment was inaugurated their temperatures were taken at 8.30 in the morning and at 6.30 in the evening.

During this period of observation, from February 5, 1919, to February 10, 1919, 12 men reported at sick call with varying degrees of tonsillitis. Of these, three were admitted to the hospital, complaining of sore throat, headache and malaise. One, No. 44, had a fever (38.6° C.) for the first evening only; the temperature of the others did not reach 37.8° C., and all were discharged in 72 hours or less, having completely recovered from their complaints.

Another man, F. K. E., No. 18, presented a more perplexing syndrome. He became ill the day of his arrival on the island, having felt perfectly well before this. This volunteer, and No. 44, who had badly involved tonsils and fever of one afternoon's duration, were not accepted as fit subjects for experimentation due to physical disabilities. The clinical data of this case are herewith given:

F. K. E. (age 24, No. 18).—Not used in experiment.

Diagnosis.—Daily intermittent fever of unknown origin and paroxysmal tachycardia.

The patient said that he had always been healthy, with no serious illness except an attack of pleurisy and arthritis in February, 1918. He stated that he had had no exposure to influenza. He came to Gallups Island February 4, 1919, feeling well.

On the afternoon of February 5, 1919, the day after his arrival, the patient's temperature was 38.2° C. but he had no complaint. He turned into his bunk early and the following morning his temperature was 36.9° C. The same evening, the temperature was 38° C., the patient still feeling well, but he was admitted to the hospital for observation. He had been constipated for the three

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The next morning (Feb. 7) the patient's temperature was 37° C. and he complained of some headache and vague pains in the epigastrium and chest. The headache was frontal, temporal, and occipital in distribution and was worse when the temperature was highest. There was but little lassitude, weakness, or depression at any time, and all subjective symptoms disappeared each morning with the subsidence of the fever. No vertigo, photophobia, cough, dyspnea, hemoptysis, vomiting, diarrhea, jaundice, nor any symptoms pointing to genito-urinary involvement developed. The patient never complained of sore throat.

Physical examination on admission was negative.

During his stay in the hospital, the patient's temperature intermitted daily, varying from 36.2° in the morning to 39.2° C. in the evening and gradually coming down on the seventh day to normal, but rising to 37.6° on the ninth day and to 38° on the twelfth. The pulse (except as noted below) ranged from 72 to 100; the respirations from 18 to 24. The leucocyte count of February 9, was 15,800, dropping to 7,800 four days later. Urine analyses were negative.

On February 13, 1919, a careful examination of the patient was made by Drs. Leake, Lake, and Richey. It was decided that, in view of the leucocytosis, the intermitting fever, continuing for a week or more without severe symptoms, and the absence of prostration, back pains, photophobia, flushing, or cough, the case could not be diagnosed as influenza, though the possibility of an atypical attack could not be entirely ruled out.

On the evening of February 16, 1919, after the temperature had been normal for five days, while the patient was lying quietly in bed, he became conscious of palpitation. On examination at this time it was found that the apex beat was 220 and quite regular. There were no signs of cardiac decompensation. In the course of 20 or 30 minutes, immediately after the application of an ice bag to the precordium, the heart rate returned to 72 as rapidly as it had increased. He said that he has had at least three such attacks, the last occurring four months ago. In the absence of gross irregularity and a pulse deficit, this attack was considered one of paroxysmal tachycardia.

The patient was discharged from the hospital on February 17, 1919, having quite recovered. His nasopharyngeal flora at the time was pneumococcus, staphylococcus, a gram negative diplococcus and *B. influenzae*.

In view of the bare possibility that this might have been an anomalous case of influenza and on account of the presence of a cardiac arrhythmia, the patient was considered as not a fit subject for experimentation.

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The routine procedure preparatory to any of the experiments consisted in a careful examination of each volunteer's nasopharynx, a leucocyte count, and a nasopharyngeal culture. All inoculations were made by instilling the material into the nares and mouth by both spray and dropper. The total amounts of material given to each volunteer varied from 1.5 c. c. to 10 c. c., according to the quantity available. The recipient was made to lie flat on his back during the time the material was being instilled, and for several minutes afterwards, to insure the maximum effect.

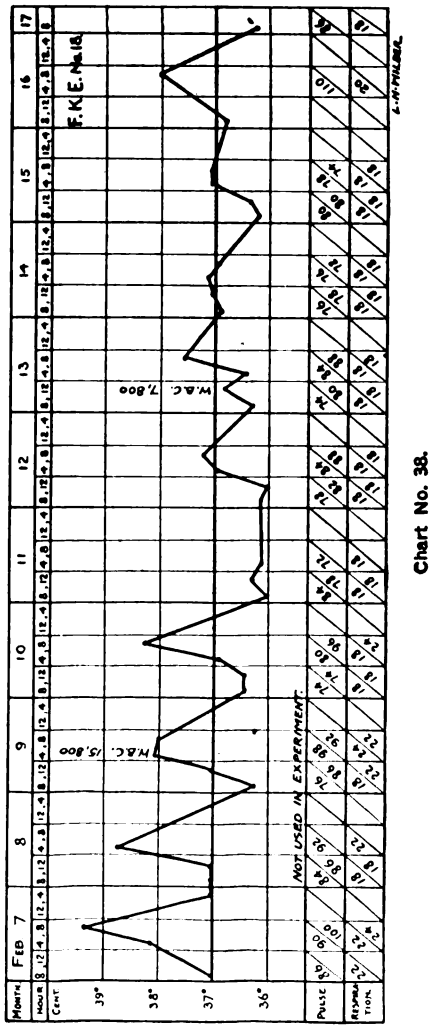

Chart No. 38.

The men were turned into previously prepared quarters and were isolated from the other volunteers. Precautions were taken to prevent any contact with those not having to do with the experiment. Food was dispensed through a common galley in some cases, while in others the men were permitted to prepare their own food. Temperatures were taken two or three times a day on each group under experimentation. The men were allowed certain hours for routine exercise and remained very happy and contented.

Especial care was taken in the collection of the presumably infectious material from donors. The nose and pharynx were syringed with from 50 to 60 c. c. of sterile, physiologic salt solution or Locke's solution. Locke's solution was used in all transfers from human sources except from donor 1. This material for flushing was carried in a well-stoppered, sterile bottle containing glass beads. A separate autoclaved syringe was used for each donor. The patient was made to cough into the previously collected material so that very fresh nasopharyngeal secretions were obtained. The material, having been [illegible] was transported as rapidly as possible to the volun-

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teers. The time elapsing between the donor and the volunteer was never longer than two hours, and, when the donor was on the station, the interim was within 15 minutes. By means of the glass beads, the secretions and washings were thoroughly emulsified and cultures made before they were finally distributed among the recipients of the particular group. Each group was kept under surveillance for six or seven days subsequent to the inoculations. Upon discharge another nasopharyngeal culture was taken.

Those who became ill were immediately admitted to the hospital, where they were attended by the medical officers in charge of the experiment and one or two nurses.

The details of the various experiments, with the flora of the nasopharynx before and after inoculation, are shown in Table II. The predominant organism in the nasopharyngeal examination is indicated in each instance by black-faced type.

EXPERIMENT I.

FEBRUARY 11, 1919—3 P. M.

Attempt to produce influenza by inoculation with Mathers's coccus.

Recipients.—The 10 recipients, Nos. 1, 2, 3, 6, 7, 8, 9, 10, 15, and 42, employed in this experiment, were all in good physical condition. Their ages ranged from 20 to 30—the average age being 24.4 years. Two, Nos. 3 and 10, showed some enlargement of the tonsils. None of the men gave a history of a previous attack of influenza. Four, Nos. 1, 2, 3, 6, had been in close contact with influenza patients; four, Nos. 7, 10, 15, 42, had had a casual contact, two, Nos. 8 and 9, said they had not been exposed to the disease.

Material.—The material consisted of four strains of cocci—63 AT, 40 AN_6, 65 CT_2, 6 BNP_4—somewhat similar to, or identical with, those obtained by Dr. Mathers from cases of influenza at Camp Meade. These were available to us through the courtesy of Dr. Hektoen. Subcultures—29 hours old—in dextrose bouillon, were used. Macroscopically, there was a wide difference in the character of growth: Strain 65 CT_2 showed a very scanty growth, while strain 6 BNP_4 grew as a heavy, white, flocculent precipitate. The others formed a heavy uniform cloud in the medium. Smears taken at the time of instillation showed gram positive, pleomorphic organisms, occurring in pairs and short chains. Some tended to a lanceolate shape. The control cultures, on blood agar plates, varied considerably, ranging from green colonies to gray colonies with a greenish halo. All hemolyzed the blood agar after the third day.

Procedure.—A heavy pooled suspension in broth was administered into the nasopharynx by spray and dropper, so that each man

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received 1.5 c. c. while reclining. Nos. 1, 2, 3 received a spray of 4 per cent solution of sodium bicarbonate previous to the inoculation—in sufficient quantity to make the nasal secretions alkaline to litmus paper. In a similar manner, Nos. 6, 7, 8, were given a 0.5 per cent solution of acetic acid until the reactions were distinctly acid. Nos. 9, 10, 15, 42, who received no preliminary treatment, showed a slightly acid reaction.

Results.—The results were entirely negative during a period of seven days observation; the men remained without fever or other disturbance of their health. Unfortunately, the predominating organism of the nasopharyngeal flora was a green-producing one before inoculation except No. 15, where staphyloccoccus played the leading rôle. After seven days' isolation, the predominating bacterium had been maintained in all individuals, and the flora was not materially altered. It is of interest that the incidence of *B. influenzae* increased from 40 per cent before inoculation to 80 per cent seven days afterwards.

EXPERIMENT II.

FEBRUARY 13, 1919—5.30 P. M.

Attempt to transmit influenza via respiratory tract from secretions of acute case.

Recipients.—These 10 men, Nos. 5, 11, 13, 14, 16, 17, 19, 20, 21, and 40, were in good physical condition. Nos. 13 and 14 had enlarged tonsils, while No. 5 showed a somewhat congested throat. Their ages were from 19 to 26, the average age being 22. Two, Nos. 5 and 17, gave a history of no exposure to influenza; five, of casual contact, Nos. 11, 13, 16, 19, and 20; two, Nos. 14 and 21, had been in close contact, and one, No. 40, probably had influenza while at Portsmouth, N. H., in October, 1918.

Donor.—The donor was Dr. A. C., who treated influenza patients during the autumn and winter, but had not previously contracted the disease. On February 12, 1919, at 5 p. m., he had slight malaise and chilly sensations; by 8.30 p. m. these, and especially a pain in his back, had become so severe that he left a banquet, and on reaching home at 9.30 p. m. his temperature was 100.8° F.; at midnight it was 102.2°, and at 8 o'clock the next morning 102.4°; at 1 p. m. the temperature was 103.4°. When the nasopharyngeal washings were obtained, at 3.25 p. m., the white count was 6,900; he had a continuous headache and pain in his back, was chilly, with a slight coryza—a tenacious mucoid discharge partially blocking the nares. This coryza did not persist and was never prominent. There was no soreness of the throat nor tenderness of the neck, nor evidence of tonsillar infection, but the fauces were reddened, the face was flushed, and the conjunctivae suffused. There was an occasional cough with an increased

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pharyngeal secretion, though the throat felt dry. There were no urinary symptoms and the chest examination was negative. During the two following days there was a slight sore throat and some muscular tenderness on the right side of the neck, without glandular enlargement. The temperature fell rapidly and convalescence progressed satisfactorily without complications.

Material.—The material consisted of nasopharyngeal washings and bronchial secretions from a patient acutely ill of influenza (Dr. C.), 22 hours after the onset of his illness. The material was collected in 30 c. c. sterile physiologic salt solution; this was thoroughly emulsified and control cultures were made, which revealed the presence of a pneumococcus, *B. influenzae*, *Streptococcus hemolyticus*, *Staphylococcus albus* and *Staphylococcus citreus*, a gram-negative diplococcus, and an organism similar to *B. mucosus capsulatus*.

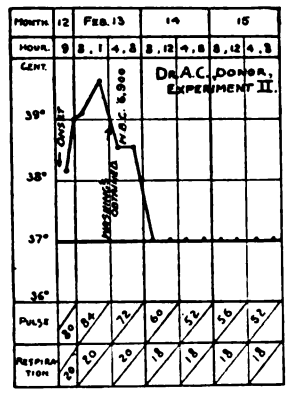

Chart No. 39.

Procedure.—Two hours after its recovery from the patient, 3 c. c. of the material were instilled into the nasopharynx of each of the 10 men by spray and dropper. All men were in the recumbent position at the time of inoculation.

Results.—Two men from this group became ill. One, J. J. C., No. 14, after an incubation period of 72 hours, developed a mild attack of acute follicular tonsillitis. His history follows:

J. J. C. (age 22, No. 14).—Experiment II.

Diagnosis.—Acute lacunar tonsillitis (mild).

The patient says he has had grippe-like attacks every year for several years, none of which have necessitated going to bed. His last attack occurred over a year ago. During the recent epidemic, he was in close contact with influenza patients.

Seventy-two hours after receiving the material in this experiment the patient's temperature rose to 38° C. and he complained of a sore throat. Examination at this time showed his tonsils to be enlarged, inflamed, and the crypts, particularly the left, to be filled with a purulent exudate. A blowing, systolic murmur at the apex was the only other positive finding. It was noted that a moderate amount of exercise increased the pulse rate.

A few hours after being in bed the temperature returned to normal. The tonsillar condition was readily amenable to treatment and in three days the patient made a good recovery from this mild attack. Hemolytic streptococci were found in the flora, but the predominating colony remained a pneumococcus.

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The other man, F. W. B., No. 5, after an incubation period of five days, developed a syndrome which was very suggestive of influenza, as follows:

F. W. B. (age 23, No. 5).—Experiment II.

Diagnosis.—Influenza (?).

Incubation period.—Five days (?).

The patient says he has always been quite well, never having been in bed on account of sickness. During the last few weeks he has had an anterior urethritis, which is discharging at the present time.

On the evening of February 18, 1919, five days after he had received the nasopharyngeal washings, the temperature was found to be 38.2° C. The morning temperature had been normal. Upon questioning the patient, he said he had some anorexia that morning and after lunch went to bed. Toward evening he complained of a generalized headache, chilly sensations over entire body, backache, weakness, and malaise. A cough which had been present before the inoculation became more intense on this day. At no time was sore throat a source of complaint.

The patient was put to bed. At 7 o'clock of the same evening the temperature, pulse, and respiration were 38.2° C., 82, and 20, respectively. The leucocytes (during digestion) were 13,000. Physical examination showed a flushed face, a congested and rather mottled posterior pharyngeal wall, but no tonsilar involvement. Nothing of note could be made out in the chest. The temperature reached its fastigium on the third day, when it rose to 39.2° C. At this time the pulse was 100, and the respirations 26. The leucocyte count was 10,500, his normal being 8,400. Urinalysis was negative. Other than diminished breath sounds over the left base, posteriorly, and a faint blowing systolic murmur at the apex, the physical signs of the chest were negative. The cough still persisted, with no sore throat. The case so closely simulated one of influenza that a passage experiment (No. IV) was done, using this patient's secretions as the source of the material.

The following day, February 22, the temperature dropped to 37.2° C., returning to normal on the fourth day after onset, but rose to 38° for a single observation on the sixth day. One week after the onset the white cell count was 9,000. He made an uneventful recovery, being discharged well February 27, 1919, nine days after the onset.

On February 19 the bacteriological examination of the nasopharynx showed a pneumococcus and a slightly hemolytic streptococcus to be the predominating organisms. *B. influenzae* and a gram-negative diplococcus were also found. Before inoculation his flora consisted of a green-producing coccus, a hemolytic streptococcus, *B.* staphylococcus, and a member of the *B. mucosus capsu-*

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In the absence of any definite involvement of the tonsils the diagnosis in this case would seem to rest between influenza and a streptococcic sore throat. In favor of influenza is the presence of headache, backache, depression, and exacerbated cough, while against it is a relatively high leucocyte count.

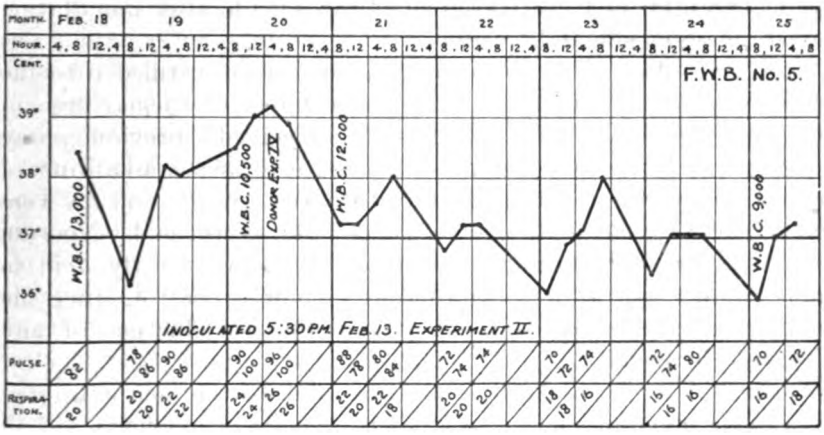

Chart No. 40.

The other men, after six days' observation, were discharged. They had not become ill. The flora of these individuals was not essentially altered. Of the two men in this experiment who gave no history of prior contact with influenza, one suffered a probable attack five days after inoculation with material from a case in the first 24 hours of his illness.

EXPERIMENT III.

FEBRUARY 17, 1919—4 P. M.

Attempt to produce influenza by nasopharyngeal inoculation of *B. influenzae* (Pfeiffer) and *Staphylococcus aureus*.

Ten men, Nos. 22, 24, 25, 26, 27, 28, 30, 31, 32, and 33, were subjects of this experiment.

Recipients.—Their physical status was good. Nos. 27, 32, and 33 had hypertrophied tonsils. Their ages were from 20 to 36 with a mean of 24.3 years. Seven men, Nos. 22, 25, 26, 27, 28, 31, and 32, gave a history of no exposure during the recent epidemic of influenza; one, No. 33, of casual contact; one, No. 30, of close contact, and one, No. 24, had a typical attack of influenza while at Deer Island in September, 1918.

Material.—Ten 30-hour-old cooked blood agar slants, on which were luxuriant growths of a virulent strain of *B. influenzae* (200,000,000 being fatal to white mice), were scraped and the organisms were suspended in 20 c. c. nutrient bouillon.

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Heavy growths of *Staphylococcus aureus* on three agar slants were scraped into 10 c. c. nutrient bouillon and pooled with a suspension of *B. influenzæ*. The suspension was very turbid and an attempt to count it was futile on account of marked clumping of the organisms. It was estimated that there were from three to five billion of each type of organism in 1 c. c. Control cultures made after inoculation proved the organisms to be viable.

Procedure.—3 c. c. of the pooled emulsion were instilled into the nasopharynx of each man by spray and dropper, the usual precautions being observed. Nos. 22, 24, and 25 received a previous spray and gargle of 2 per cent sodium bicarbonate to insure alkalinity of the secretions, whereas the secretions of Nos. 26, 27, and 28 were rendered acid by the application of 0.5 per cent acetic acid. Nos. 30, 31, and 32 received nothing, their reactions being slightly acid to litmus paper. No. 33 was regarded as a contact control, since the condition of his tonsils did not justify the introduction of any extraneous material.

Results.—After seven days observation, none of the men exhibited any untoward symptoms—save F. A. H., No. 22, who contracted an attack of acute lacunar tonsillitis on the fifth day after inoculation.

F. A. H. (No. 22, age 22).—Experiment III.

Diagnosis.—Acute tonsillitis:

The past history of this patient indicates that he has always enjoyed very good health and was not exposed to influenza during recent months.

Five days after receiving the suspension of *B. influenzæ* and *Staphylococcus aureus* the patient developed a sore throat. He complained of some anorexia, malaise, and headache. Examination of the throat revealed hypertrophic, dusky red, rather edematous tonsils. No exudate could be made out in the crypts. There was no cough, photophobia, nor general aching. His temperature showed daily variations from 38.6° C. to 36.4° C., gradually coming down on the fifth day to normal. The pulse was never higher than 88. The white count was 6,800, his normal being 5,600. Urine analysis showed no albumen or casts. The patient made a good recovery.

Despite the fact that *B. influenzae* and staphylococci were instilled into his nasopharynx the predominating organisms at the onset of his present illness remained a green-producing organism and *Streptococcus hemolyticus*. The instilled organisms were also present, but in fewer numbers.

It was thought that the throat condition was ample to account for the syndrome which he presented.

The "before" and "after" findings in the nasopharynx were interesting. Prior to inoculation, 6 of the men showed *B. influenzae* to be pre[illegible] their throats, whereas 7 days after instillation all the

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10 members of this group were found to harbor this organism. On the other hand, staphylococcus was encountered in seven instances before and in the same number after the experiment. In four of these, staphylococcus became the predominant organism subsequent

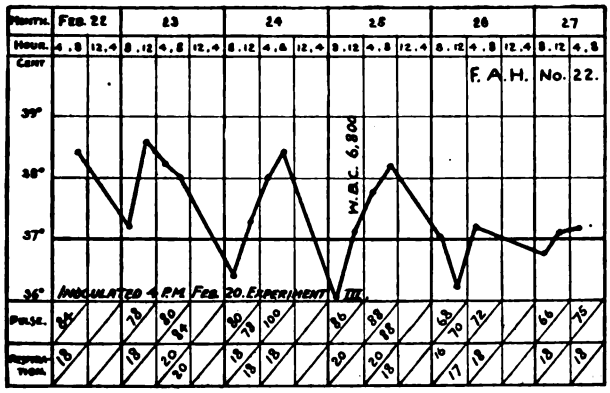

Chart No. 41.

to the inoculation, while it had been such in only one case beforehand. *B. influenzae* was the predominating colony in no instance before the experiment, and in one afterwards. This man, No. 24, was the only one in the whole contingent who was known to have had an attack of influenza prior to these experiments. Before this artificial inoculation with the Pfeiffer bacillus and staphylococcus, a green-producing coccus was the predominating organism, but after the inoculation the Pfeiffer bacillus persisted in its predominance for at least 16 days.

EXPERIMENT IV.

FEBRUARY 20, 1919—4 P. M.

Attempt to transmit influenza through upper respiratory tract from secretions of an apparent case (experimental) of influenza on the third day. Passage experiment.

Recipients.—Ten men: Nos. 23, 34, 35, 38, 39, 41, 45, 46, 47, and 49 constituted the volunteers. Except for Nos. 38 and 49, who had moderately hypertrophic tonsils, none of these volunteers presented any physical defects. Their ages ranged from 19 to 26; the average was 22.9 years. Five men, Nos. 34, 41, 46, 47, and 49 gave a history of no exposure to influenza; two, Nos. 38 and 45, gave a history of casual contact; and three, Nos. 23, 35, and 39, of close contact.

Donor.—F. W. B. No. 5. (See Experiment II.)

Material.—Nasopharyngeal washings and bronchial secretions were collected in Locke's solution from 45 to 50 hours after the appearance

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of the initial symptoms. After thoroughly shaking with glass beads, a control culture was made, which showed a pneumococcus (Type II) *B. influenzae*, *Streptococcus hemolyticus*, staphylococcus, a gram-negative diplococcus, and a member of the *B. mucosus capsulatus* group. These findings were practically identical with those of the donor, whose washings this donor received.

Procedure.—Within 15 minutes after its recovery, 3 c. c. of the material was instilled in the usual manner in each case while the subjects were lying down. In order to produce a hyperemia of the mucous membranes, the oleoresin of capsicum (0.0025 per cent) was sprayed into the nose and mouth of Nos. 23, 34, and 35. Nos. 38, 39, and 41 received a preliminary spray of adrenalin 1–2,000, in the hope of producing an ischaemia. Both procedures appeared to be efficacious for the end in view. Nos. 45, 46, 47, and 49 were given no preparatory applications.

Results.—During a seven-day surveillance none of these men showed any symptoms referable to their inoculations. The bacteriological findings of the nasopharynges at the end of a week were practically the same as they were prior to the instillation.

EXPERIMENT V.

FEBRUARY 22, 1919—6.30 P. M.

Attempt to transmit influenza via upper respiratory tract from pooled secretions of four typical, very early cases.

Recipients.—Four men, Nos. 1, 2, 3, and 7, received this inoculation. These men had emerged from experiments in good condition. Their ages were 21, 27, 22, and 24 years, respectively. No. 3 showed some enlargement of the right tonsil. Three of them, Nos. 1, 2, and 3, gave a history of close contact with influenza patients in recent months and the other, No. 7, of casual contact.

Donors.—The donors, four in number, were carefully selected from an epidemic which was occurring at the time at the United States Naval Prison, Portsmouth, N. H.

The naval prison, with a population of about 2,200 inmates, is located within the navy yard at Kittery, Me., across the Piscataqua River from Portsmouth, N. H. The influenza epidemic of September, 1918, appeared in the prison earlier than among the personnel of the navy yard or the population of Portsmouth, N. H. The intercommunication among the inmates of the prison is very free, and constant accessions are being received, but there is little communication between the prison and the navy yard, or the city of Portsmouth. The September epidemic in the prison began September 12 and comprised about 400 cases with 30 deaths, the height of the epidemic occurring on September 16. From February 16 to 21, 1919, about 6 influenza cases per day are on record, but, on February 22, 34 new

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cases were reported. In this second outbreak there were, in all, 215 cases and 2 deaths, the largest number of cases (38) occurring on February 25. Except in its somewhat lessened extent and its markedly lessened mortality, this epidemic resembled the September outbreak. The inmates had meanwhile changed, in part, and in general other individuals were attacked than those who were sick in September. The same rapidity of spread through the institution to a maximum a few days after the beginning, with a succeeding diminution almost as sudden in number of cases, the same spread throughout the whole institution without marked localization, and the same symptoms were observed as in the first outbreak. At the time of the second outbreak a considerable number of cases of tonsillitis also appeared. The four donors for this experiment were selected as having had their first symptoms only a few hours previously. Many of the other very recent admissions to the sick bay stated that they had had premonitory symptoms as much as 24 hours before reporting sick. These four cases all had a rather sudden onset, with headache, backache, photophobia, prostration, and presented a flushed face with suffused conjunctivae, fauces and palate reddened, but no apparent tonsillar involvement or enlargement of the cervical glands. One other man selected as a donor, with similar symptoms and signs, had a nasal hemorrhage while his pharynx and nose were being washed out, and his washings consequently were not used; this patient later had a very severe but nonfatal broncho-pneumonia. The four donors whose washings were transferred to the volunteers in Experiment V were as follows:

S. M., age 19, entered the prison April 17, 1918, but during the September outbreak of influenza was on a ship which was moored at the prison and which was little affected; he stated that he had never had influenza previously, was not subject to cold, but had frequent attacks of sore throat. He knew of no definite exposure to influenza. At noon on the day of the experiment, six hours before the washings were obtained, he was suddenly and completely prostrated and had to be carried into the sick bay, having been in his usual health during the forenoon. He complained of severe headache and backache, his conjunctivae were suffused and his face and fauces were flushed. There was no tonsillar exudate. On the day following the experiment his white cells were 7,600 per cubic millimeter, and the throat culture showed hemolytic streptococcus, pneumoccoccus, *Micrococcus catarrhalis*, and staphylococcus, but no streptococcus viridans or influenza bacillus. On the third day in the sick bay, when his temperature was reaching normal, he complained of a slight sore throat, but had no exudate or other evidence of local infection. His heart and lungs were normal on examination, also his urine. He recovered promptly without complications, having had fever only three days, 103° F. at the highest, and was discharged from sick bay after eight days.

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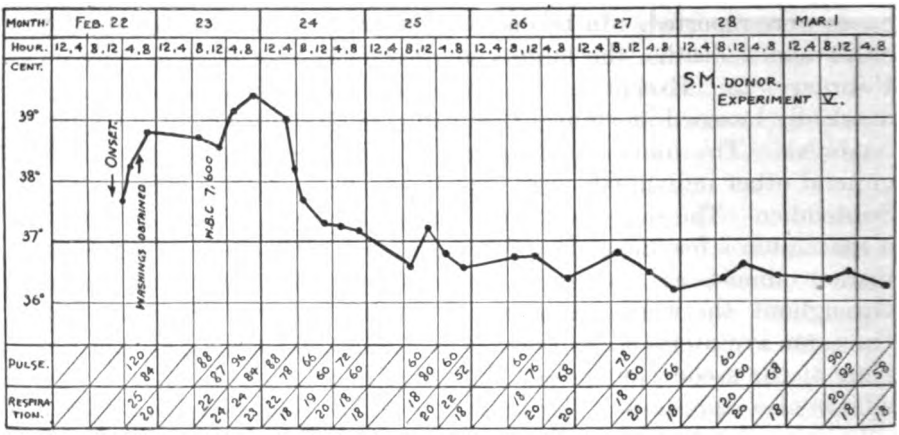

Chart No. 42.

W. L., age 21, entered the naval prison January 24, 1918, but during the September outbreak was on the same prison ship as S. M. No exposure to, nor prior attack of influenza is known. He states that he is not subject to colds. At noon on the day of the experiment, six hours before his nasopharyngeal washings were obtained, he had a sudden onset of severe headache, backache, and pains in chest, with extreme prostration. His face was slightly flushed, his fauces were reddened, and his conjunctivae were suffused. He had a slight cough with muco-purulent sputum, but examination of his chest and of his urine were negative. His leucocytes were 8,800 on the day after the experiment, and pneumococci, staphylococci, and *Micrococcus catarrhalis*, but no influenza bacilli or streptococci, appeared on throat culture. Malaise and weakness continued for several days, but his temperature, 103.5° at the highest, reached normal on the fifth day and did not go above normal after that day.

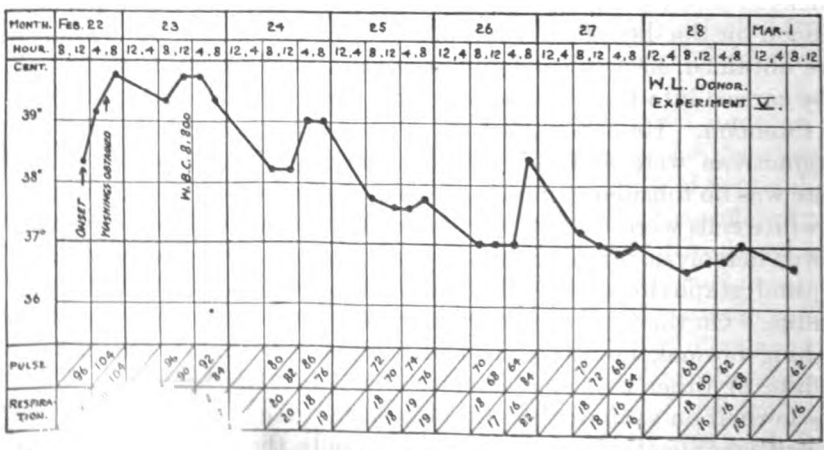

Chart No. 43.

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O. J. B., aged 20, had been in the prison since May, 1918, but had had no previous attack of epidemic influenza. On July 4, 1917, he had a slight rise in temperature with cough, mild malaise, and muscular pains, diagnosed as influenza, but he returned to duty in two days. At 4 o'clock on the afternoon preceding the experiment, 26 hours before his washings were obtained, he had an onset of very severe prostration, backache, headache, photophobia, and cramps in abdomen. He had no sore throat at any time. When his washings were taken his temperature was 104.3°. It reached normal on the fourth day, but showed some elevation for three days thereafter, though no complications were observed. His white blood cells were 14,200 on the day after the experiment, and his throat culture showed *Streptococcus viridans*, *Micrococcus catarrhalis*, and staphylococcus, but no hemolytic streptococcus, pneumococcus, or influenza bacillus.

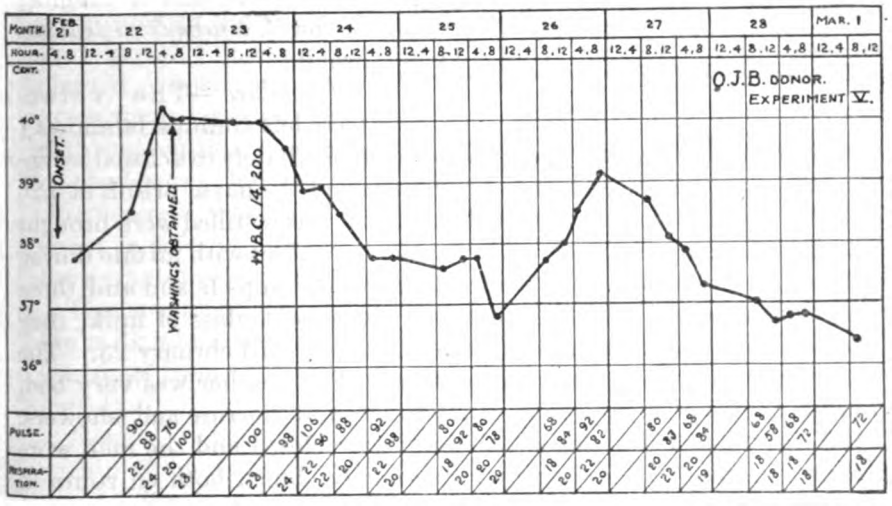

Chart No. 44.

J. P. K., aged 21, had been in the prison since December, 1918. During the autumn outbreak he was at the New York receiving ship and the Deer Island detention camp, but had had no influenza. He stated that he was subject to frequent attacks of sore throat and coryza. An hour after midnight preceding the experiment, 17 hours before his throat and nose were washed out, he was taken sick with a very severe backache, headache, and pain in his legs. He had a slight sore throat, but physical examination revealed only a pharyngitis. His white cells were 14,000 per cubic millimeter on the day after the experiment, and throat culture showed *Streptococcus viridans* and *Micrococcus catarrhalis*, no influenza bacilli, hemolytic streptococci, or staphylococci. He had fever for only 24 hours (maximum 101.2° F.), but was sick for four days and made an uneventful recovery.

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Material.—The material consisted of a mixture of the crude nasopharyngeal washings and bronchial secretions from the four donors in Locke's solution. The suspension was thoroughly shaken in a sterile container with glass beads. The control cultures showed a green-producing organism, presumably the pneumococcus, to be the predominating one, and, in addition, *Staphylococcus albus* and *aureus*, *Streptococcus hemolyticus* (alpha and beta), *M. pharyngis siccus*, *B. influenzae*, a gram-negative diplococcus, and a member of the *B. mucosus capsulatus* group.

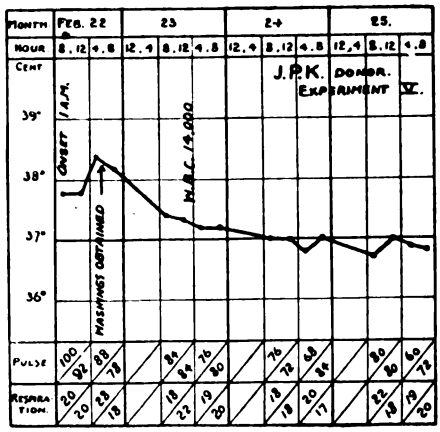

Chart No. 45.

Procedure.—The volunteers left Gallups Island at 1 p. m. on the *Vigilant* and were transferred immediately to a closed seven-passenger limousine at 1.35. They arrived at the naval prison at 4.20 p. m., were isolated, and after the material was instilled were brought back in the same manner. They came in contact with no one during the entire trip except one Marine guard from Gallups Island and those administering the material to them. Save for 1 glass of milk, they received no food from noon February 22 to noon February 23. The trip was trying—130 miles by machine. The weather was very bad, being cold and damp, with alternating snow flurries and showers. Despite the fact that the automobiles were closed and the men wore their "peacoats," they were all thoroughly chilled both en route to the prison and on their return. Upon their return to Gallups Island after midnight, they were thoroughly tired. Within 15 minutes after its recovery from the donors, 10 c. c. of the pooled washings were instilled, by spray and dropper, into the nose and throat of each volunteer. Considerable of the material was swallowed. In addition, 100 c. c. of the crude washings from six donors, including the above-mentioned four, were well mixed in 900 c. c. fresh milk. Each man drank 250 c. c. of the milk, or 25 c. c. of the washings.

Two additional donors, originally intended for Experiment VI as healthy inmates of the prison during the epidemic, were found to be somewhat abnormal when their washings were obtained. Being thus excluded from Experiment VI, they were counted as possible atypical or early cases of influenza, and their washings were mixed with those of S. M., W. L., O. J. B., and J. P. K., for the ingestion of Experiment V. Their histories follow:

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J. J. B. had a flushed face, with reddened fauces and pharynx, and when questioned complained of slight headache and malaise of a few hours' duration; his temperature was normal, but on the following day he reported at sick call with a headache and malaise, and did not go to work that day, though he remained up and about. A week later he was discharged from the Navy. His leucocyte count on the day after the experiment was 14,000, and his throat culture showed hemolytic streptococci, *Micrococcus catarrhalis*, and staphylococci, but no influenza bacilli, *Streptococcus viridans*, or pneumococci.

L. C. H., age 22, complained of headache on the afternoon of the experiment. His temperature was normal, and a later inspection of his medical history showed that he had been a frequent visitor at sick bay during his nine months in the Navy. He had been operated on for chronic appendicitis in June, 1918. At the Deer Island detention camp he was listed as having had influenza with the usual symptoms for the week following September 27, 1918, and again at the Portsmouth Prison on November 25, 1918. He has frequently complained of sore throat and of lame back. On the day following the experiment his white cells numbered 7,400 per cubic millimeter, and a throat culture showed hemolytic streptococci, pneumococci, and staphylococci, but no influenza bacilli, *Streptococcus viridans*, or *Micrococcus catarrhalis*. Ten days after the experiment he was again in sick bay for two days with the diagnosis of influenza, but the symptoms were atypical.

The washings from these two men were used only for mixing with the milk which was taken by the volunteers of Experiment V. The washings from the other four were used both for instillation and for ingestion.

Results.—Two of the four men, H. A., No. 1, and W. S. B., No. 7, within 40 hours became ill with attacks of acute follicular tonsillitis, due to *Streptoccus hemolyticus* of the beta variety.

In this regard it is of note that the predominating organism of the nasal pharyngeal flora changed in all four men from a green-producing bacterium before the inoculation to an intensely hemolytic streptococcus after the inoculation. Morphologically, the colonies from the four men were identical. This was true even as late as seven days after the introduction of the material within their nasal pharynges.

H. A. (age 21, No. 1).—Experiment V.

Diagnosis.—Acute lacunar tonsillitis.

The patient had always been quite well. Although in close contact with influenza patients during the recent epidemic, he had not been taken ill himself.

Within 40 hours after receiving the material in this experiment and 34 hours after the end of a cold night ride, the patient began to feel ill, complaining of sore throat, headache, anorexia, and malaise.

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The temperature rose rapidly to 39.2° C., the pulse to 100°, while the respirations were 22. The leucocyte count was 12,000, 9,000 being his count prior to the experiment. Examination of the throat showed an extensive exudate in many of the crypts on both sides.

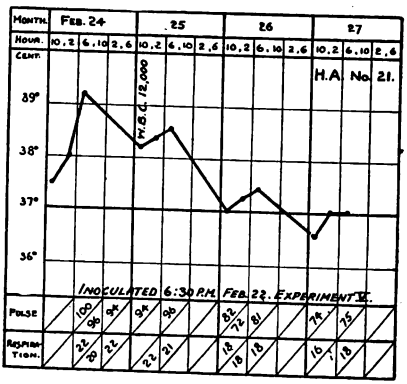

Chart No. 46.

Cultures showed an intensely hemolytic streptococcus in practically pure culture. Forty-eight hours after the onset the temperature dropped from 38.6 to normal and patient was discharged as well on the following day.

The hemolytic streptococcus in this case was culturally identical with one isolated from the pooled secretions of the donors.

W. S. B. (age 24, No. 7).—Experiment V.

Diagnosis.—Acute lacunar tonsillitis.

The past health of this man had always been good. He may have experienced a casual exposure during the recent outbreak of influenza.

The time of onset (40 hours after instillation of secretion) and the course of his illness, even to the bacteriological findings, are almost identical with those of H. A., No. 1, except that the tonsillar exudate was not apparent until the morning after onset, whereas No. 1 showed a follicular exudate the evening before. It was for this reason that W. S. B., No. 7, was selected as a donor for a passage experiment (Experiment VII) on the day of onset, inasmuch as it was desired to obtain extremely early material from the possible cases of influenza.

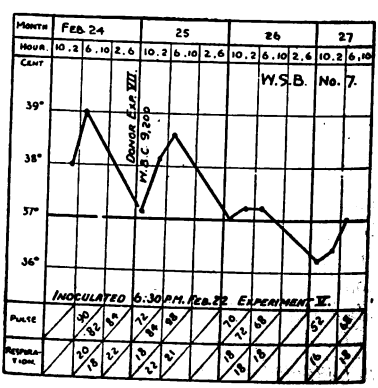

Chart No. 47.

The headache was the most prominent symptom though the fauces and tonsils were reddened when the secretions were obtained for Experiment VII. The temperature rose abruptly to 39° C. and in two days regained normal; the white cell count was 9,200, his normal being 7,600. A hemolytic streptococcus very similar to

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the one isolated from the tonsil of No. 1, was by far the predominating colony in this instance.

EXPERIMENT VI.

FEBRUARY 22, 1919—7 P. M.

Attempt to transmit influenza via upper respiratory tract by instillation of pooled nasopharyngeal secretions from persons in contact with early cases of influenza.

Recipients.—These four volunteers (Nos. 8, 36, 37, and 43) were in good physical condition. Their ages were 30, 22, 25, and 24, respectively. The histories of Nos. 8, 36, and 37 showed that they had not been exposed during the recent epidemic, while No. 43 had experienced a casual contact.

Donors.—The 10 donors employed in this experiment were selected by reason of the fact that they were in a dormitory at the Portsmouth Naval Prison from which two cases of influenza had been removed within 24 hours. All at the time of securing the material were apparently in good health, the intent being to obtain the washings in the incubation period, in the event that one or more of these men would subsequently develop influenza..

Their initials, ages, leucocyte count, and the throat organism found on culture the day after the experiment, were as follows:

Initials.	Age.	White count.	Hemolytic strep.	*Strep. viridans.*	Pneumococcus.	*M. catarrhalis.*	Influenza bacillus.	Staphylococcus.
H. J. D.	18	8,000	+	0	0	+	0	+
F. P. F.	20	8,400	+	0	0	0	+	+
P. A. J.	21	11,200	+	+	+	0	+	0
H. V. L.	26	6,800	+	0	0	+	+	+
A. J. M.	22	6,400	+	0	+	+	0	0
E. J. M.	27	9,200	+	+	0	+	0	0
W. H. P.	20	7,800	+	+	0	0	0	+
C. H. S.[1]	26							
P. R. S.	18	6,500	0	0	0	+	0	+
J. J. W.[1]	22							

[1] Examination not made.

Of these, only H. J. D. had had influenza during the autumn epidemic. P. A. J. and E. J. M. had been on the same ship, comparatively free from influenza, with donors S. M. and W. L. of Experiment V, during the 1918 outbreak.

Following Experiment V, two days after serving as donor, W. H. P. had an indisposition lasting only a day, with headache, a temperature of 101°, and no throat symptoms. On the possibility of this being influenza, he was kept in bed for five days.

Seven days after serving as donor, H. V. L. had a mild pharyngitis lasting about a week, but none of the 10 donors developed the typical symptoms of influenza.

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Material.—The material consisted of the pooled nasopharyngeal washings and bronchial secretions from the 10 donors, which had been collected in Locke's solution. It was well shaken in a sterile flask containing glass beads. The control cultures showed the presence of a green-producing organism, resembling a pneumococcus, *Staphylococcus aureus* and *albus*, *Streptococcus hemolyticus* (alpha and beta) *B. influenzae*, *M. pharyngis siccus*, and a moist gram negative diplococcus, diphtheroids, *Pneumococcus mucosus*, and one of the *B. mucosus capsulatus* group, presumably *B. Friedlaender*.

Procedure.—The same itinerary was followed by this group as described in Experiment V., but the volunteers were carried in another limousine and kept entirely separate from the volunteers of Experiment V. Within 20 minutes after its recovery, 10 c. c. of the material was administered into the nose and throat by spray and dropper. In addition, enough of the secretions were added to milk, so that when 250 c. c. was ingested, 60 c. c. of the nasopharyngeal secretions were taken into the stomach.

Results.—In none of these men, during a week's observation, were any untoward symptoms noticed. Save for an increased incidence of *Streptococcus hemolyticus* (*beta*) the flora of these men was not particularly altered by the inoculation.

EXPERIMENT VII.

FEBRUARY 24, 1919—7 P. M.

Attempt to transmit influenza via upper respiratory tract by inoculation of nasopharyngeal secretions from a supposed early case. Passage experiment.

Recipients.—Ten volunteers, Nos. 9. 10, 11, 13, 15, 16, 17, 20, 21, and 42 were used in this experiment. Nos. 9, 10, 15, and 42 had been left without result from Experiment I, while the other six were not affected by the inoculations in Experiment II. Nos. 10 and 13 had moderately enlarged tonsils. The remaining eight were apparently physically fit. Their average age was 22.1 years, the extremes being 19 and 27 years. Nos. 9 and 17 had had no exposure to influenza; Nos. 11, 13, 15, 16, 20, and 42 had had casual contact and Nos. 10 and 21 close contact.

Donor.—The source of the inoculated material in this experiment was W. S. B., No. 7, who was ill following the inoculations made in Experiment V. In the desire to secure material in the very early hours of the disease, and, in this case, to demonstrate infectivity by passage, material was obtained in the ninth hour after the onset of sy[illegible]s. Unfortunately, on the following day, it was realized [illegible]umptive diagnosis of influenza was in reality probably [illegible]much as a definite lacunar tonsillitis developed. (See [illegible]n W. S. B., Volunteer No. 7, under experiment V.)

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Material.—Nasopharyngeal washings and bronchial secretions were collected as in the previous experiments. The bacteriological controls showed two types of *Streptococcus hemolyticus* to be present in large numbers. The more common appeared on the blood agar plate as a rather large, gray colony with a moderate zone of hemolysis, whereas the other type grew as a pin-point, gray colony, with a much wider and more intense hemolytic halo. In addition, a green producing bacterium, *Staphylococcus aureus*, and *B. influenzae* were noted.

Procedure.—In accordance with the method previously described, 5 c. c. of the material were instilled into each of the volunteers within 15 minutes after its recovery from the donor.

Result.—Of the 10 men in this group, one, No. 20, left within 48 hours after inoculation, at which time he was in good health. Five of the remaining 9, Nos. 9, 15, 16, 17, and 21, developed attacks, apparently, of tonsillitis, due to *Streptococcus hemolyticus* (*beta*), of whom three, U. L. C., No. 15, E. W. D., No. 16, and C. D., No. 17, became so ill that they were put to bed in the hospital. The other two, with visible tonsillar inflammation, Nos. 9 and 21, experienced practically no constitutional symptoms. The apparent incubation period of all these cases varied from 36 to 144 hours. Their recovery was complete. One man, P. J. S., No. 42, 66 to 120 hours subsequent to the nasopharyngeal instillation, developed symptoms similar to those of influenza. The remaining three, out of the nine completely observed, developed no symptoms.

The clinical data on Nos. 16, 17, 15, and 42 are as follows:

E. W. D. (age 21, No. 16).—Experiment VII.

Diagnosis.—Acute lacunar tonsillitis.

Incubation period.—Thirty-six to forty-two hours.

Save for an attack of pneumonia in 1911, the previous health of the patient has been very good. He had a casual contact with influenza patients during the epidemic.

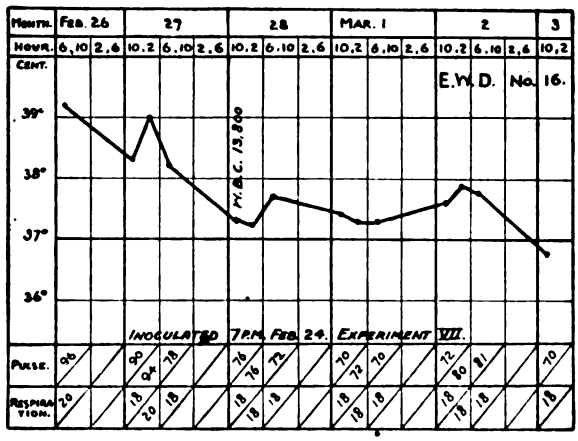

Chart. No. 48

Forty-two hours subsequent to his inoculation, after mild symptoms lasting six hours, the patient was suddenly seized with headache, chilliness, stiffness in joints, and weakness. The throat was sore, but on examination showed nothing more than a moderate con-

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gestion. At this time his temperature was 39.2° C., his pulse 96, and his respirations 20. The white cell count was 13,800, his normal being 6,500. The prostration was slight. The next day the crypts of his tonsils contained a purulent exudate, which yielded an almost pure culture of streptococcus hemolyticus, growing in small colonies with a wide zone of hemolysis. On the third day the temperature dropped to 37.2° C. and the patient felt much better. On the fifth day the temperature was normal, a good recovery ensuing.

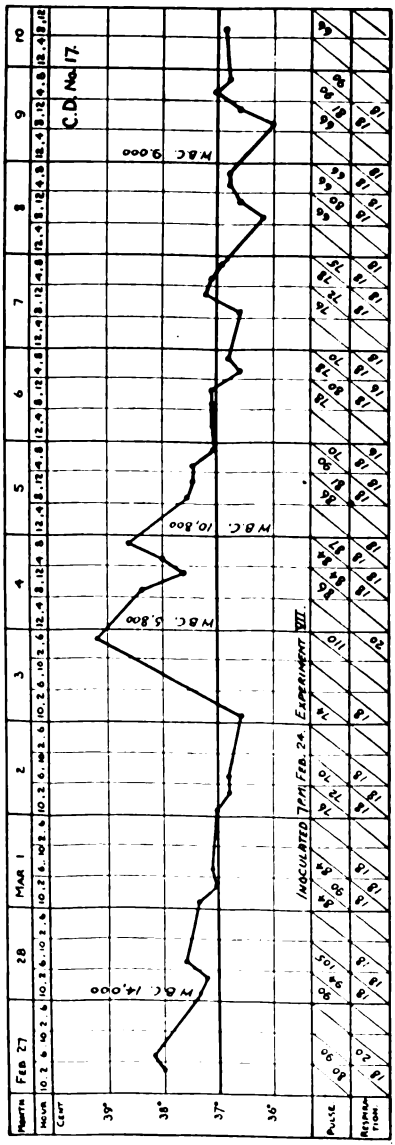

Chart No. 49.

The hemolytic streptococcus had supplanted a green-producing organism as the predominating one. This streptococcus was morphologically similar to one isolated from the secretions of the donor.

C. D. (age 21. No. 17).—Experiment VIII.

Diagnosis.—Acute lacunar tonsillitis.

Incubation period.—Forty-six to sixty-six hours.

Aside from the history of a few previous attacks of tonsillitis, the patient's health had been good. He had no exposure during the recent outbreak of influenza.

The patient was admitted to the hospital on the afternoon of February 27, having had a temperature of 37.8° C. the day before. At the time of admission the temperature was 38. The white count was 14,000. The onset had been insidious, and at no time did the patient complain of [illegible] but a sore throat and a slight headache. A small p[illegible]date on the right tonsil on the day of admission [illegible] in a membranous-like fashion. Repeated smears

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and cultures were negative for *B. diphtheriae*. The temperature reached normal on the third day and the throat cleared up. On the fifth day the patient was allowed to get up and in a few hours his temperature rose rapidly to 39.2° C. At this time the white cells were 5,800, increasing to 10,800 the next day. His average count before the illness was 8,300. Upon being put to bed, the temperature reached normal again in three days, and the patient was discharged on the twelfth day of his illness after his temperature had remained below 37° C. for five successive days. The white count on discharge was 9,000.

The secondary rise of temperature was not attended by any sore throat, and examination of the pharynx failed to demonstrate anything other than enlarged tonsils. There was no photophobia, cough, nor particular depression. The leucocyte count was 5,800, rising to 10,800 the next day.

The throat cultures on the second day of his illness as well as after the recrudescence showed an intensely hemolytic streptococcus to be the predominating colony. It resembled the pin-point colony described in the donor's secretions.

The second pyrexia presented a somewhat different picture from the first, which was that of a very definite case of tonsillitis. However, in the absence of any more definite evidence, it is fair to assume that the condition might be attributed to the hemolytic streptococci overwhelmingly predominant in the throat on both occasions.

J. L. C. (age 20, No. 15).—Experiment VII.

Diagnosis.—Acute lacunar tonsillitis.

Incubation period.—Six days.

Other than appendicitis with operation in 1917, the patient has always had good health. Since autumn he has only experienced a casual contact with influenza patients.

About 144 hours after his nasopharyngeal instillations, having felt exceptionally well during the preceding day, the patient began to complain of headache, stiff neck, dryness of the throat, photophobia, and chilly sensations. His throat was sore for one morning only. The subsequent day the temperature rose from 37.4° C. in the morning to 38.8° C. in the evening. The pulse varied from 90 to 96, the respirations were 18, and the leucocyte count was 6,000, the count before the experiment, 8,900. At this time the throat was distinctly sore, though physical examination was quite negative. The following day, which was the second day of his illness, the temperature dropped suddenly to 37° C. and did not go above 37.6 until the fifth day, when, upon getting out of bed it rose to 38.2 in the evening. The white cell count was never above 6,600. The tonsils became moderately enlarged on the third day and showed two small patches of exudate, culture of which gave an almost pure growth of intensely

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hemolytic streptococcus. On the seventh day the patient felt so well and his throat had apparently cleared up to such an extent that he was allowed to accompany his shipmates to Deer Island.

The case, in spite of the low leucocyte count and the lack of corelation in time between the symptoms and the throat findings, may be assumed to be tonsillitis. The finding of the streptococcus in the tonsilar cultures in such numbers was more than suggestive of a process similar to that in the other members of this group who were taken ill.

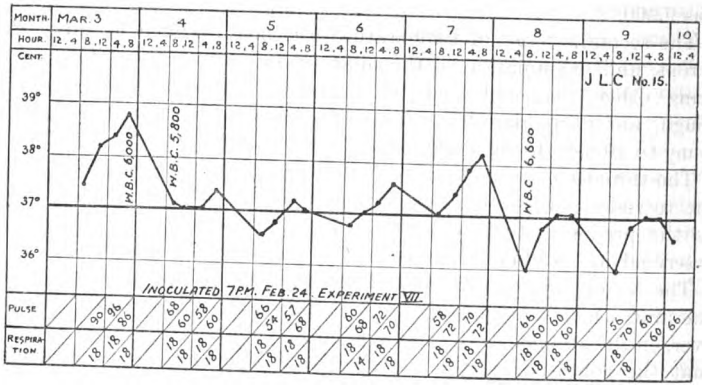

Chart No. 50.

P. J. S. (age 21, No. 42).—Experiment VII.

Diagnosis.—Influenza.

Incubation period.—Sixty-six to one hundred and twenty hours.

The patient had always enjoyed very good health, though he had never been robust and was inclined to be timid and introspective. He had been ill for two months when 10 years old with typhoid and again at 15 with pneumonia. He had never had influenza and only a casual contact with influenza patients in recent months.

By his own statement the patient had not felt well since he received his inoculation, five days previously. He reported sick two days after inoculation, but he had no fever and examination was negative. Four days after inoculation the temperature was 37.3° C. and the next evening it was 37.8°. He was then admitted to the hospital with frontal headache, an annoying cough which had developed suddenly, and pains of moderate intensity in chest, back, and abdomen. He slept poorly. The following day his temperature rose abruptly to 39.4° C. in the morning, and to 39.9° in the evening. The pulse was 105–118 and the respirations from 24 to 26. The patient now was conscious of a fever, had a "splitting" headache, backache, and pains in chest, abdomen, and extremities, with photophobia.

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The cough which persisted throughout the course of his illness was accompanied by a tough, mucous expectoration. The leucocyte count was 6,800, his normal being 8,200. Physical examination showed a flushed face with injected conjunctivae, a dusky red throat, with no exudate, a rather rapid heart rate, and negative findings over the pulmonary area. Culture of the nasopharynx yielded a green-producing organism with the characteristics of a pneumococcus, also a hemolytic streptococcus, a gram negative diplococcus, *Staphylococcus aureus* and *B. influenzae*.

The following day, March 3, 1918, the patient was seen by Lieut. Commander McGuire, United States Navy Medical Corps, who found râles posteriorly over both lower lobes and said that in an epidemic the case would surely be called influenza. The urine analysis was negative and the white cell count had fallen to 4,200. The temperature, pulse, and respiration were, on March 4, 38° C., 78 and 18.

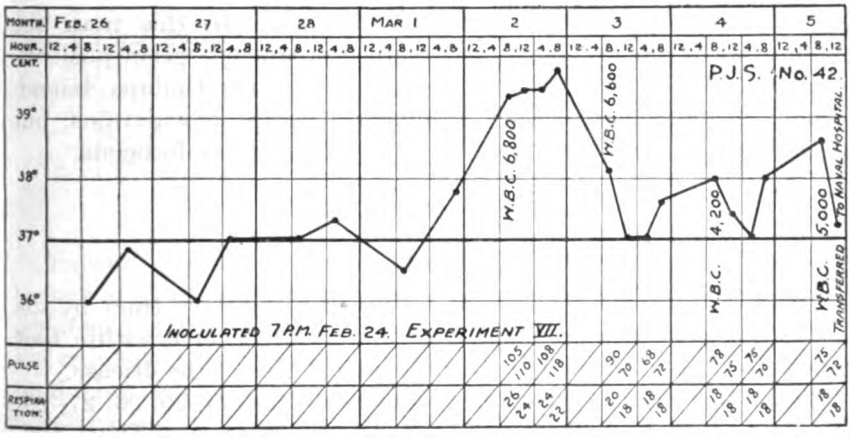

Chart No. 51.

A distressing cough prevailed, but the patient had lost, to a considerable degree, the depression and lethargy of the earlier hours of his illness. On the fifth day of his hospitalization, March 5, 1919, the temperature became 38.6 at 8 a. m., the cough was worse and quite productive, and, while no consolidation could be elicited, numerous transitory râles occurred over the bases of both lungs. The leucocyte count was 5,000. In view of the continuation of the pulmonary findings, however vague, and a slight increase of cough, temperature, and white count, it was deemed advisable to transfer the patient to the United States Naval Hospital, Chelsea. Fortunately, he did not develop a bronchopneumonia. His sputum continued abundant and contained influenza bacilli, and micrococcus catarrhalis during the first three days at the naval hospital. On March 10, besides the influenza bacilli, *Streptococcus viridans* and Type IV pneumococcus were

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found. His cough was severe, with pulmonary râles, subnormal temperature, and pain in the side. On March 11 he had a chill and his temperature rose to 38.3, leucocytes to 12,000, with headache, general pains, and injected conjunctivae. The temperature returned to normal in 12 hours. The sputum continued to give about the same bacteriological picture with influenza bacilli in great numbers. He progressed thereafter to a satisfactory recovery. The syndrome presented by this individual was not comparable in any way to the illnesses of Nos. 16 and 17.

The bacteriological findings of the nasopharynges of this group are striking. Prior to inoculation, a green-producing organism was the predominating one, while only three showed the presence of a hemolytic streptococcus. The cultures taken for periods varying from two to seven days after the instillations showed the predominating organism to be a hemolytic streptococcus with intense hemolytic properties in all ten members of the group, except in the case of P. J. S., No. 42, who apparently developed influenza. In this man the predominating colony remained a green-producing, gram-positive, lanceolate diplococcus up to the time of leaving Gallups Island. Hemolytic streptococci began to appear after the inoculations, but were always outnumbered by the green-producing diplococcus.

EXPERIMENT VIII.

FEBRUARY 24, 1919—7. 30 P. M.

Attempt to transmit influenza via upper respiratory tract by the inoculation into the nasopharynx of material recovered within four hours after the initial symptoms of a typical case of the disease.

Recipients.—There were nine volunteers, Nos. 24, 25, 26, 27, 28, 30, 31, 32, and 33. Their ages varied from 20 to 36. These men were used seven days previously in Experiment III, with negative results throughout, having been discharged seven hours before this experiment was begun. All were in good physical trim, and their throats were healthy in appearance. Nos. 27, 32, and 33 had moderately enlarged tonsils. Six men, Nos. 25, 26, 27, 28, 31, and 32, had had no exposure to influenza; one, No. 33, a casual contact; one, No. 30, close contact and one, No. 24, had a typical attack of influenza while at Deer Island in September, 1918.

Donor.—The donor, having had no prior attack of influenza, in spite of repeated exposure, was in close contact with the donors of Experiment V, going to Portsmouth by automobile, and returning in the same way during a severe storm, reaching Boston at 5 a. m.; 44 hours after the exposure the onset occurred with headache, backache, pain in thighs, prostration, a temperature of 38.4°, reaching 39.9° in 6 hours, a dry throat with reddened fauces but no tonsillitis.

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There were lachrymation and injection of the conjunctivæ for 48 hours, and photophobia for 4 days. An infrequent, paroxysmal cough with moderate mucopurulent expectoration began 24 hours after onset, but began to diminish after 3 days. The leucocyte count was 7,000. Anorexia and slight nausea were present during the first 48 hours, but there was no vomiting. The fever lasted only 60 hours, and convalescence was uninterrupted.

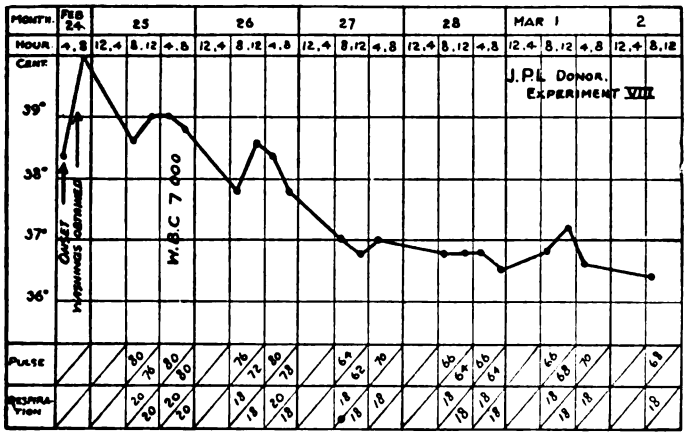

Chart No. 52.

Material.—In the prescribed fashion, nasopharyngeal washings and bronchial secretions were collected in Locke's solution, four hours after the onset of the initial symptoms. Bacteriological examination of the emulsified secretions at the time of inoculation yielded a green-producing organism (with characteristics of a pneumococcus), a gram-negative diplococcus, *B. influenzae*, and a few faintly hemolytic streptococci. The presence of *B. proteus vulgaris* prevented isolation of the streptococcus. Another culture, taken from the donor's nasopharynx nine days after the onset of his illness, showed the same types of organisms to be present except for the *B. proteus vulgaris*.

Procedure.—In 1 hour and 45 minutes after the collection of the secretions from the donor, 4 c. c. were given by the nose and throat to each of Nos. 26, 28, 30, 31, and 33 by spray and dropper, while Nos. 24, 25, 27, and 32 received 5 c. c. each, in the same manner.

Results.—One volunteer, L. F. J., No. 25, after an incubation of 36 hours, pursued a symptom-complex identical with that encountered in influenza. He gave a history of no other exposure to influenza.

L. F. J. (age 20, No. 25).—Experiment VIII.

Diagnosis.—Influenza.

Incubation period.—Thirty-six hours.

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The patient states that he had an attack of diphtheria at the age of 7. During the recent epidemic of influenza he was not exposed to any cases, as far as known. He arrived on Gallups Island February 6, on which day he complained of a sore throat. He said he had never been troubled with tonsillitis prior to this attack. His temperature was 37.5° C. and the crypts of his tonsils contained a purulent exudate. The temperature dropped to normal the ensuing day and he was discharged from the hospital 16 days before the present experiment, having completely recovered.

Thirty-six hours after receiving the instillations in this experiment, the patient complained of a pain in his chest, cough, and a general aching over his body, particularly in his back. His temperature at this time was 38.6° C. Associated with these symptoms was a certain amount of chilliness, anorexia, and malaise. The leucocyte count was 9,000, his usual count being 10,000.

Physical examination revealed nothing of note except a soft murmur over the aortic area, diastolic in time and transmitted into the great vessels of the neck, and the throat showed no lesions except a redness of the fauces on the third day. Angina was never a complaint. The murmur persisted and might have been overlooked when he came to Gallups Island. The temperature rose rapidly to 39.4° C., remaining above 38° C. for about 48 hours and then dropping rapidly to 37.4° C. The pulse was never higher than 126. The leucocyte count at this time was 4,400. Two days later it was 4,600. On the second day of his illness, the patient developed considerable photophobia and postorbital pain, with general headache. Backache and generalized pains persisted until the third day after the onset. The urine analysis was negative. The bacteriological examination of the nasopharynx yielded *B. influenzae* as the predominating colony; a gram negative diplococcus, diphtheroids, a few pneumococci, and *Streptococcus hemolyticus* of both alpha and beta types were also found. Following three days of normal temperature the patient was allowed out of bed.

On March 3, five days after onset, examination by Lieut. Commander McGuire showed some degree of cardiac hypertrophy and a few râles at the apex of the left lung, anteriorly. There was nothing in the previous history of the patient which would lead one to suspect incipient tuberculosis. The patient made a speedy recovery.

By way of résumé, it will be seen that 36 hours after inoculation from an early, typical, uncomplicated case of influenza, the patient suddenly developed a cough, general pains and later photophobia and postorbital aching. The temperature went abruptly to 39.4° C. and came down as suddenly within 48 hours. There was no sore throat. A leucopenia was present—4,400. The predominating c lora of the nasopharynx changed from a hemo-

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lytic streptococcus before the inoculation to *B. influenzae* shortly after the onset of his illness.

The case was apparently one of influenza, though rather gradual in development. On the third day, after the temperature had reached normal, his secretions were used to inoculate volunteers in Experiment IX.

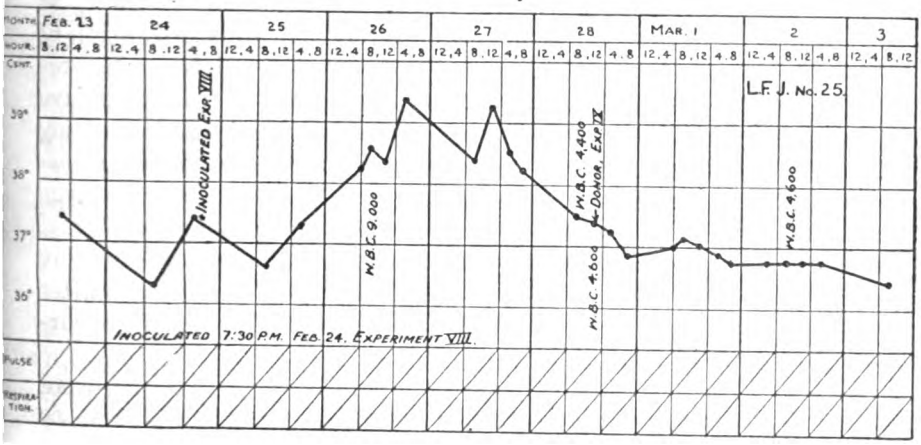

Chart No. 53.

The other volunteers of this group remained quite well during the nine days of observation.

EXPERIMENT IX.

FEBRUARY 28, 1919—3 P. M.

Attempt to transmit influenza via upper respiratory tract by inoculation with nasopharyngeal washings obtained 54 hours after onset. Passage experiment.

Recipients.—Fifteen men, Nos. 5, 8, 23, 34, 35, 36, 37, 38, 39, 41, 43, 45, 46, 47, and 49, were the volunteers in this experiment. No. 5 had experienced an influenza-like attack after inoculation in Experiment II, so was not inoculated on this occasion, being considered as a contact control. No. 8 had been used in Experiments I and VI. Nos. 23, 34, 35, 38, 39, 41, 45, 46, 47, and 49 were the recipients in Experiment IV, while Nos. 36, 37, and 43 were recipients in Experiment VI. All had been recently released from the several previous experiments and were in good physical condition. It was noted that Nos. 38 and 39 had rather large tonsils with prominent crypts. Their ages ranged from 19 to 30, the average age being 23.5 years. Eight men, Nos. 8, 34, 36, 37, 41, 46, 47, and 49, had never been exposed to influenza, according to their history; three, Nos. 38, 43, and 45, had had a casual contact; three, Nos. 23, 35, and 39, had had a close contact.

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Donor.—The source of the material in this experiment was L. F. J., No. 25, who developed symptoms of influenza apparently as a result of the instillation he received in Experiment VIII. An account of the clinical course of his illness has been given under the results of Experiment VIII.

Material.—Fifty-four hours after the onset of his illness, nasopharyngeal washings were collected, after the usual fashion, in 50 c. c. sterile Locke's solution. The bacteriological examination of the secretions, made at the time of inoculation, showed *B. influenzae* to be the predominant organism, accompanied by gram-negative diplococci, diphtheroids, a few green producing organisms (growing in pairs and short chains), and two types of *Streptococcus hemolyticus* (*alpha* and *beta*).

Procedure.—In the course of 15 minutes each man was given 3 c. c. of the material into his nasopharynx by spray and dropper. A note was made that the nose of one man, No. 23, bled a few minutes after the inoculation. Epistaxis, it was learned, was of frequent occurrence in this individual.

Results.—Two men, H. H. M., No. 35, and E. R. S., No. 41, were taken ill with severe attacks of acute lacunar tonsillitis within 48 hours after inoculation, and a third, T. J. S., No. 43, developed the same condition in 72 hours. The cultures from their throats showed almost pure cultures of a markedly hemolytic streptococcus. H. H. M. and T. J. S. made a good recovery in 10 days. E. R. S. developed a right-sided otitis media due to *Staphylococcus aureus* on the seventh day of his illness, after his tonsils had apparently returned to normal. The tympanic membrane ruptured spontaneously 15 hours after the first slight pain in the ear was experienced. The clinical data of these three cases is herewith appended.

H. H. M. (age 23, No. 35).—Experiment IX.

Diagnosis.—Acute lacunar tonsillitis.

Incubation period.—Forty-six hours.

The previous health of the patient had always been good. During the recent epidemic he had been in close contact with influenza cases, but never contracted the disease. In September, 1918, he was given two inoculations at 48-hour intervals, of a vaccine made from Pfeiffer bacillus, while on duty at Gallups Island.

Forty-six hours after the nasopharyngeal instillations the patient complained of a sore throat, chills, anorexia, headache, backache, and malaise. The temperature was 38° C. A few hours later it rose to 39.4° C. and then to 39.6° C. The leucocyte count was 12,000, becoming 13,000 the next day, when the temperature dropped to 38.2° C. The normal white count was 7,500. The urine analysis was [illegible] Examination of the throat showed hypertrophy of the [illegible] siderable congestion. There was marked swelling

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and tenderness of the cervical lymph nodes. On the third day after the onset of the initial symptoms there was a large quantity of exudate in the crypts of both tonsils, particularly the left. Cultures yielded many hemolytic streptococci, and a few gram negative diplococci, *B. influenzae* and pneumococci. The streptococci were very similar to the beta type encountered in the donor's secretions.

Aside from a rather distressing glandular involvement, the patient made a good recovery. The temperature returned to normal on the fifth day, and four days later the patient was allowed to return to Deer Island.

The tonsillar involvement in this case was fully adequate to account for the symptoms presented.

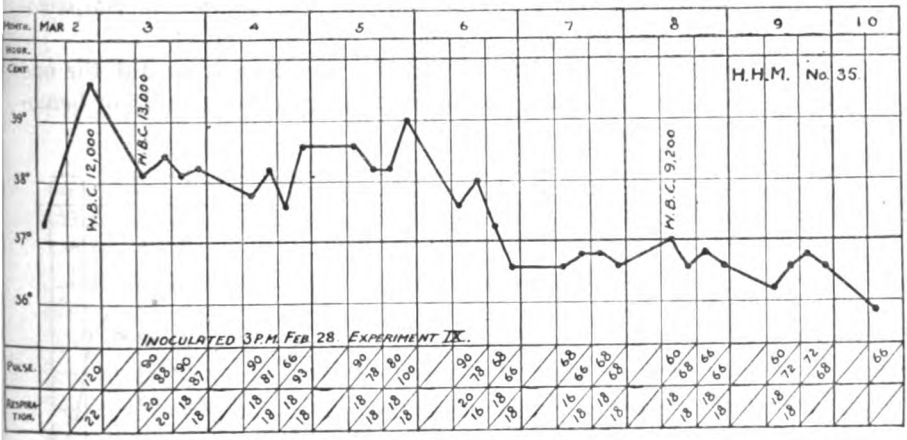

Chart No. 54.

E. R. S. (age 25, No. 41).—Experiment IX.

Diagnosis.—Acute lacunar tonsillitis, complicated by otitis media.

Incubation period (*tonsillitis*).—Forty-eight hours.

This patient had always been well and had not been exposed to any cases of influenza during the recent outbreak. He received one inoculation of influenza vaccine while at Deer Island, in August, 1918.

Forty-eight hours after the introduction of the washings from No. 25, the patient developed a sore throat and some stiffness in his neck. His temperature was 38.4° C., pulse 96, respirations 18. The leucocyte count was 14,200, his normal being 7,300. Examination of the throat showed the crypts of both tonsils to contain a purulent exudate. On the fourth day, when the temperature was slowly receding, the patient complained of some pain in the right neck and palpation revealed the presence of enlarged tender glands. The following morning the temperature, pulse, and respiration were 36.4° C., 84, and 18 respectively. That evening the temperature rose abruptly to 39.4° C. and the pulse to 104. The patient had some headache and soreness in the neck, but otherwise felt quite comfortable.

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The next day, which was the sixth day of his illness, the patient's temperature returned to normal and he felt well. The leucocyte count was 10,600. That night, however, an otitis media began, which caused rupture of the tympanic membrane.

The thick, hemorrhagic, purulent exudate yielded a pure strain of *Staphylococcus aureus*. Immediately after the rupture of the membrane, all subjective symptoms subsided. There was no tenderness over the mastoid process. The patient was sent to the Naval Hospital at Chelsea.

At the height of the tonsillitis a culture from the throat showed the predominating colony to be a hemolytic streptococcus, morphologically similar to a strain seen in the donor's secretions and in the culture from No. 35. In addition, there were *B. influenzae*, *Staphylococcus aureus* and a few pneumococci.

The staphylococcus isolated from the middle ear, as did the one seen in the tonsillar culture, showed a wide, intensive halo of hemolysis on the blood agar plate.

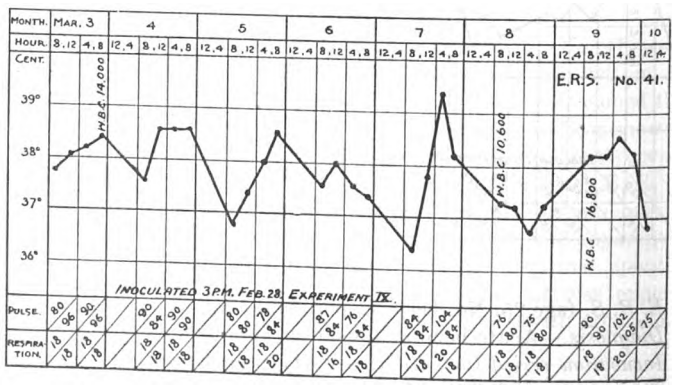

Chart No. 55.

T. J. S. (age 24, No. 43).—Experiment IX.

Diagnosis.—Acute lacunar tonsillitis.

Incubation.—Seventy-two hours.

The patient had always enjoyed good health. He had a casual contact with cases of influenza during the present epidemic. Seventy-two hours after inoculation the patient complained of headache, angina, dysphagia and malaise. His temperature was 37.6° C. and the tonsils were markedly congested and swollen. The following morning he felt quite ill and several patches of exudate were noted over both tonsils. The white cell count was 20,000. The temperature rose to 39.4° C., the pulse to 104, and the respirations were 18. Within three days the temperature returned to normal and he was discharged in a week in good condition.

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The bacteriological findings of the throat culture were hemolytic streptococci, gram negative diplococci, *Staphylococcus aureus* and pneumococcus. The first mentioned was by far the most numerous and corresponded, morphologically, with those isolated from the donor and Nos. 35 and 41.

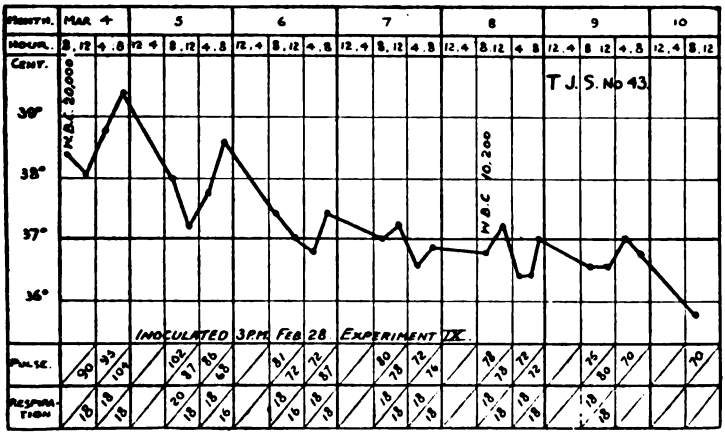

Chart No. 56.

During a period of observation, continuing over eight days, none of the other members of this squad became ill.

The bacteriological findings of the nasopharynx from this group are worthy of mention. Before inoculation a green-producing bacterium was the predominating one in 73 per cent and hemolytic streptococcus in one case (7 per cent), although this type of organism was noted in 20 per cent. Several days after the instillation, hemolytic streptococcus was the predominating organism in 40 per cent and occurred in 86 per cent, whereas the green-producing organism predominated in 46 per cent. The predominating organism of the individual who received no material but remained in the same room with the others changed from a green-producing to a hemolytic streptococcus.

BACTERIOLOGY.

Bacteriological examinations were made of the nasopharynx of each volunteer before inoculation in the several experiments and upon discharge from the experiment, as well as on those occasions where there was some indication for further investigation, and in the event any individual was taken ill. In addition, cultural controls were made of the material inoculated to determine the type and viability of the organisms inoculated where cultures were used; and to determine the bacteriologic content of nasopharyngeal and bronchial secretions where this was the material inoculated.

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The method of procuring the nasopharyngeal cultures consisted in swabbing the posterior pharyngeal wall, high in the vault, by a sterile cotton applicator or West tube. This was then inoculated on a portion of a whole, fresh, human blood agar plate, and a Petri dish containing a thin film of Levinthal's medium—cleared, cooked, human blood agar. The former medium was employed to differentiate the types of organisms, particularly *Streptococcus hemolyticus*, while the latter facilitated the detection of *B. influenzae*. The media were furnished through the courtesy of Lieut. J. J. Keegan, Medical Corps, United States Navy, from the United States Naval Hospital, Chelsea, Mass.

Plates were incubated at Gallups Island for 24 hours at 37.2°, aerobically, and the various colonies were then described by their microscopic appearance. Smears were made from grouped colonies from both plates, and from individual suspicious colonies, stained by Gram's method, and checked with the gross picture of the plate.

Particular attention was paid to Pfeiffer's bacillus on the cooked blood agar employed. On this medium the organism grew as a rather large, round, slightly elevated, clear, transparent, moist, lens-like or tear-drop colony, looking much the same as meningococcus on fresh blood agar, only more transparent. In smear, the appearance of a tiny, short, gram negative bacillus, with a distinct tendency to clumping was deemed necessary for the positive diagnosis of this bacterium.

By the very nature of the procedure, and by virtue of the fact that these examinations were carried out according to the experiment, each volunteer was as a rule cultured more than once. It has been found in reviewing the data that usually the results of the various floral examinations in one individual corresponded quite closely, and, if they did not, the discrepancy could be attributed, for the most part, to the character of a previous instillation.

In the interpretation of results, it is to be remembered that they are based on the 62 inoculations of human secretions made in seven experiments and not on the 43 volunteers as single individuals on whom these inoculations were made.

The total incidence of *B. influenzae* before inoculation was 41 out of 62 or 66 per cent, whereas the incidence in the unused 43 volunteers—that is, before any inoculation—was 48 per cent. After inoculation, 45 of 62, or 73 per cent, gave positive cultures.

It occurred as the predominating colony in one, No. 24, before inoculation with human material (but subsequent to an inoculation with Pfeiffer's bacillus itself), and in two, Nos. 24 and 25, after inoculation. It is of further interest that No. 24, the only man who gave a history of attack during the recent epidemic, showed this as the predominating organism only after these bacteria had been

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instilled into his nasopharynx; on the other hand, L. F. J., No. 25, who was in the same group, showed *B. influenzae* before and after Experiment III, but it was only after he had apparently passed through an attack of the disease, contracted in experiment 8, that they became the predominating colony, supplanting a hemolytic streptococcus.

In Experiment III, where living *B. influenzae* and *Staphylococcus aureus* were given, the former organism was isolated in 60 per cent of the 10 men before instillation, and 100 per cent seven days after instillation. It was the predominating colony in no instance before, and in one case after. On the other hand, *Staphylococcus aureus* occurred in 70 per cent before and after, but it was the predominant colony in 10 per cent before experimentation, and 40 per cent seven days subsequent to the inoculation.

In so far as it was impracticable to determine by routine sugar reactions and bile solubility, and make agglutination and complement fixation tests, all green pigment producing organisms were included under one head. By far the two most frequent components of this group were pneumococcus and *Streptococcus viridans*. The more usual one of these two was a gram positive, lanceolate, capsulated diplococcus, showing umbilication of the small, round, green, colony on a blood agar plate. Prior to the inoculations with human material, this group of organisms occurred as the predominant colony in 77 per cent of cases, and was found in 94 per cent. After inoculation, it predominated in but 60 per cent and was noted in 95 per cent. The discrepancy in the proportion of the predominating colony, before and after, can be explained, in part, by the fact that in 13 instances—in Experiments V, VII, IX—it was supplanted by *Streptococcus hemolyticus* subsequent to the instillation.

Hemolytic streptococci were encountered in 25 instances (40 per cent) before inoculation and in 47 or 76 per cent seven days after inoculation. The beta type (Smith and Brown) was the more frequent, occurring 21 times (34 per cent) before and 46 times (74 per cent) subsequent to inoculation. It formed the predominating colony in but 8 per cent prior to instillation and was predominant in four times as many men (32 per cent) after inoculation. This increase (Table II) is most evident in Experiments V, VII, and IX, in which 10 out of the 12 cases of acute lacunar tonsillitis occurred. In each instance alpha and beta types were found in the donor's secretions but the alpha type was, in no case, the predominant factor. In only one donor—that of Experiment VII—did streptococci outnumber the other bacteria. In only two cases where the beta variety dominated after experimentation was it dominant prior to that event; in one instance it occurred as the most frequent bacterium before instillation and was surpassed in number subsequently, by

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the influenza bacillus. This was evident in the case of No. 25, Experiment VIII, who apparently contracted influenza as a result of the inoculation.

The alpha type occurred alone in 4 cases (6 per cent) before, and in 1 case after inoculation. It was never seen as the predominating colony. Both types were noted together four times (6 per cent) prior to inoculation and five times (8 per cent) after the experiment.

No attempt was made to distinguish between *M. catarrhalis* and meningococcus. It was assumed that, in the vast majority of cases, *M. catarrhalis* occurred more frequently than meningococci, from the macroscopic appearance of the colonies on the fresh blood agar plate. Gram negative diplococci, including the two just mentioned organisms and *M. pharyngis siccus*, were found in 46 cases (74 per cent) before inoculation and in the same number seven days after inoculation. This type of bacterium predominated in only one case before and in none after instillation.

The recording of staphylococci was originally done according to whether they were albus, aureus, or citreus. For purposes of comparison with other organisms, these types occurred in 36 (57 per cent) of all cases before and in the same number after inoculation. Not infrequently two varieties were seen in the same culture—usually albus and aureus. Occasionally, citreus was encountered, alone or in conjunction with one of the other organisms. They were found to predominate in 10 per cent before experimentation; in only one case did they maintain the dominant place after inoculation as well.

Other types of organisms, diphtheroid bacilli, and the groups of the Friedlaender bacillus, *B. proteus*, and *B. subtilis*, were not found in many cases.

SUMMARY.

The experiments are summarized in the following charts:

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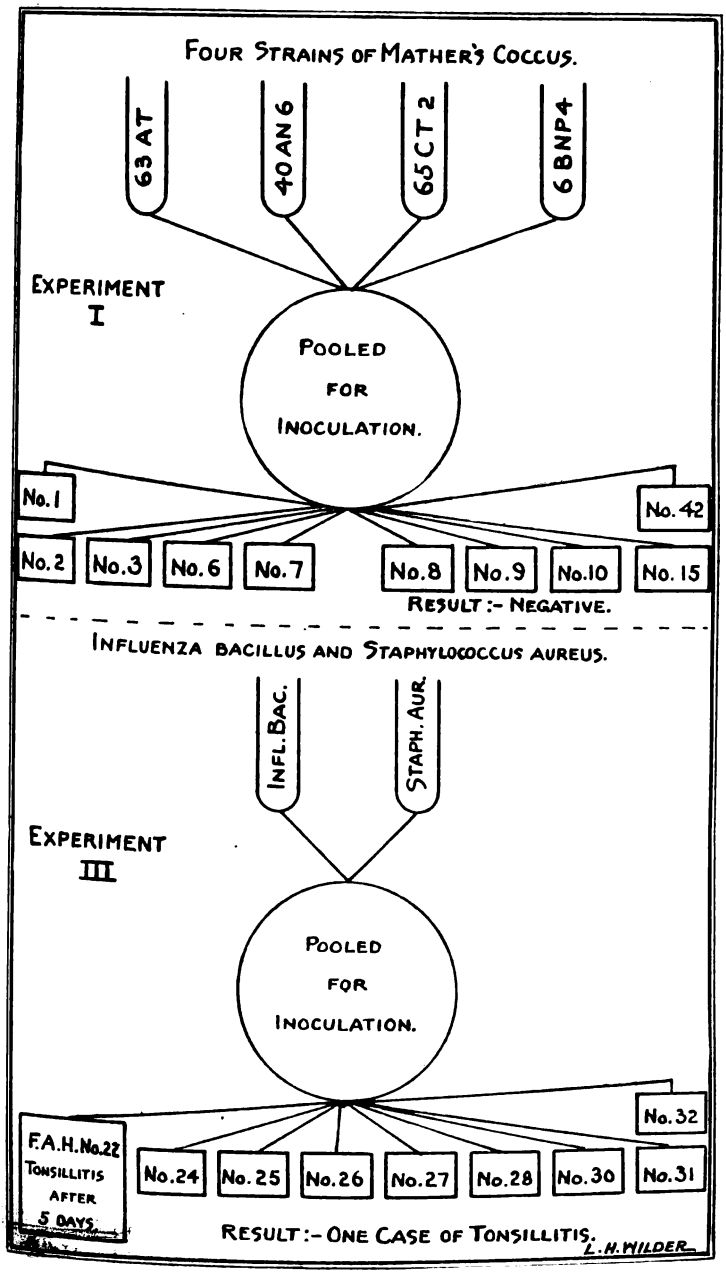

Chart No. 57.

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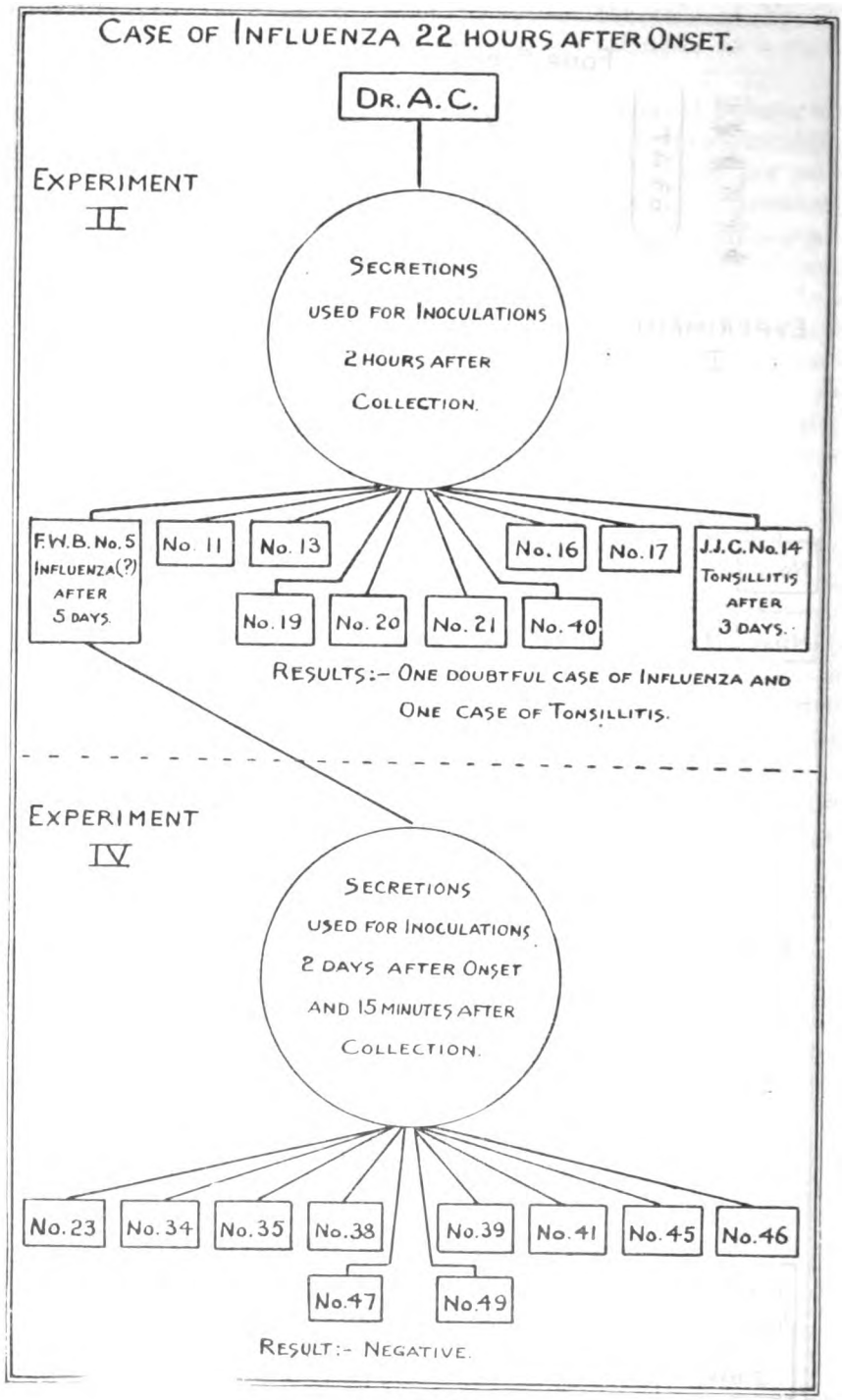

Chart No. 58.

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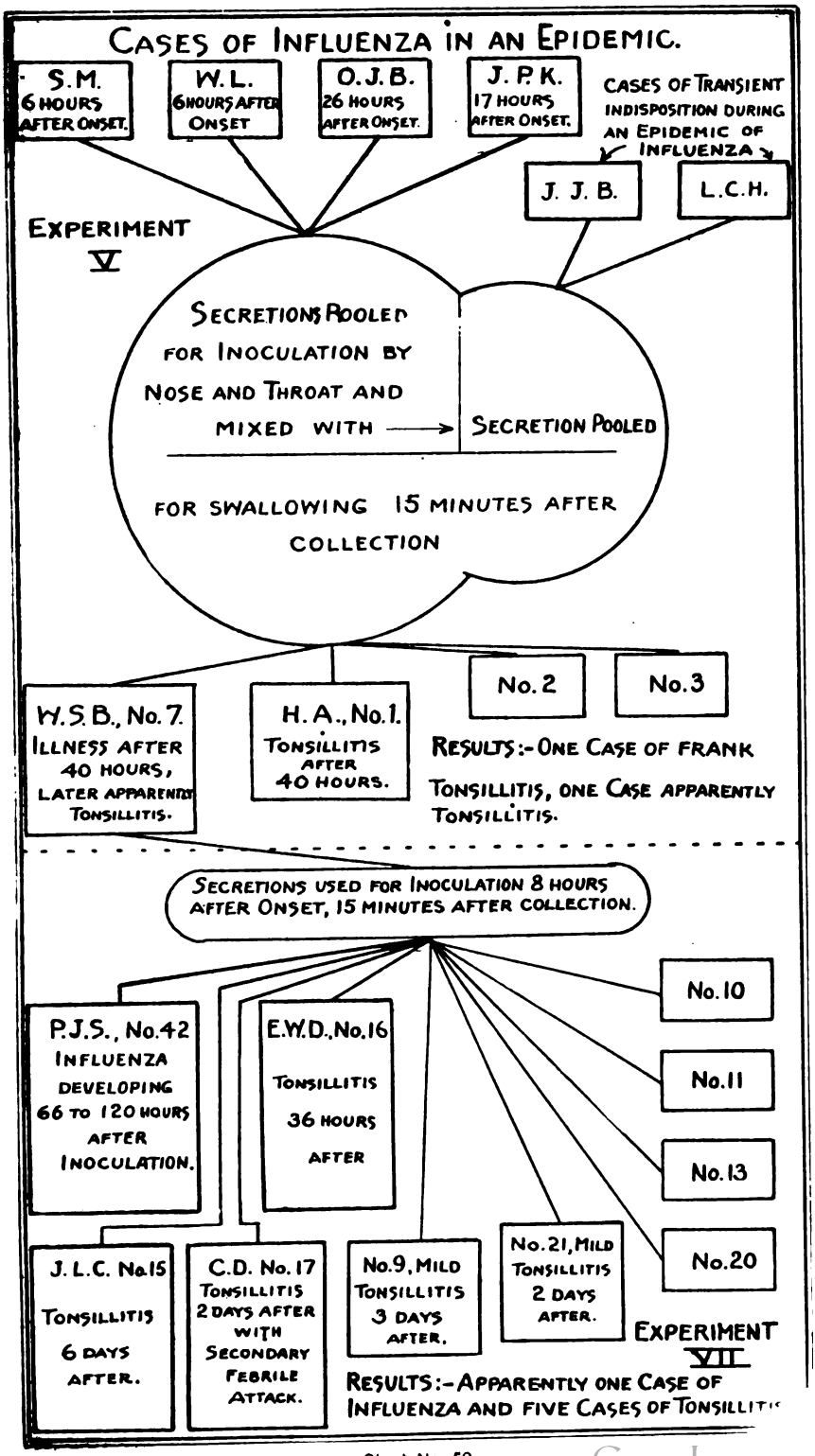
CASES OF INFLUENZA IN AN EPIDEMIC.
S.M. 6 HOURS AFTER ONSET.
W.L. 6 HOURS AFTER ONSET
O.J.B. 26 HOURS AFTER ONSET.
J.P.K. 17 HOURS AFTER ONSET.
CASES OF TRANSIENT INDISPOSITION DURING AN EPIDEMIC OF INFLUENZA
J. J. B.
L.C.H.
EXPERIMENT V
SECRETIONS POOLED FOR INOCULATION BY NOSE AND THROAT AND MIXED WITH
SECRETION POOLED
FOR SWALLOWING 15 MINUTES AFTER COLLECTION
W.S.B., No. 7. ILLNESS AFTER 40 HOURS, LATER APPARENTLY TONSILLITIS.
H.A., No. 1. TONSILLITIS AFTER 40 HOURS.
No. 2
No. 3
RESULTS:- ONE CASE OF FRANK TONSILLITIS, ONE CASE APPARENTLY TONSILLITIS.
SECRETIONS USED FOR INOCULATION 8 HOURS AFTER ONSET, 15 MINUTES AFTER COLLECTION.
P.J.S., No. 42 INFLUENZA DEVELOPING 66 TO 120 HOURS AFTER INOCULATION.
E.W.D., No. 16 TONSILLITIS 36 HOURS AFTER
No. 10
No. 11
No. 13
No. 20
J.L.C. No. 15 TONSILLITIS 6 DAYS AFTER.
C.D. No. 17 TONSILLITIS 2 DAYS AFTER WITH SECONDARY FEBRILE ATTACK.
No. 9, MILD TONSILLITIS 3 DAYS AFTER.
No. 21, MILD TONSILLITIS 2 DAYS AFTER.
EXPERIMENT VII
RESULTS:- APPARENTLY ONE CASE OF INFLUENZA AND FIVE CASES OF TONSILLITIS

Chart No. 59.

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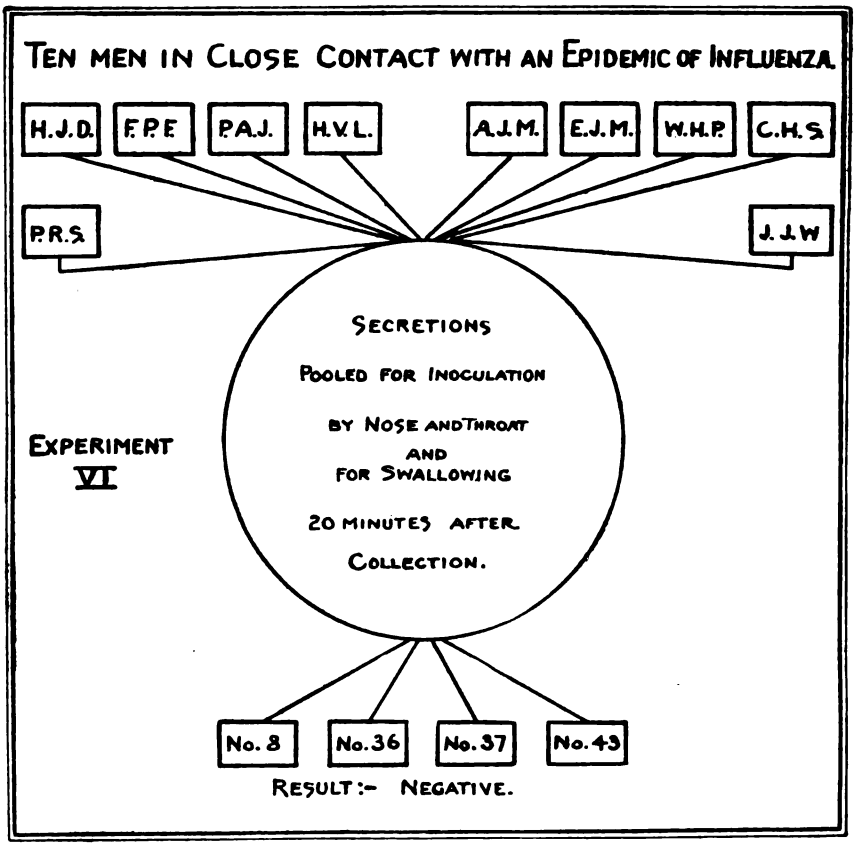

Chart No. 60.

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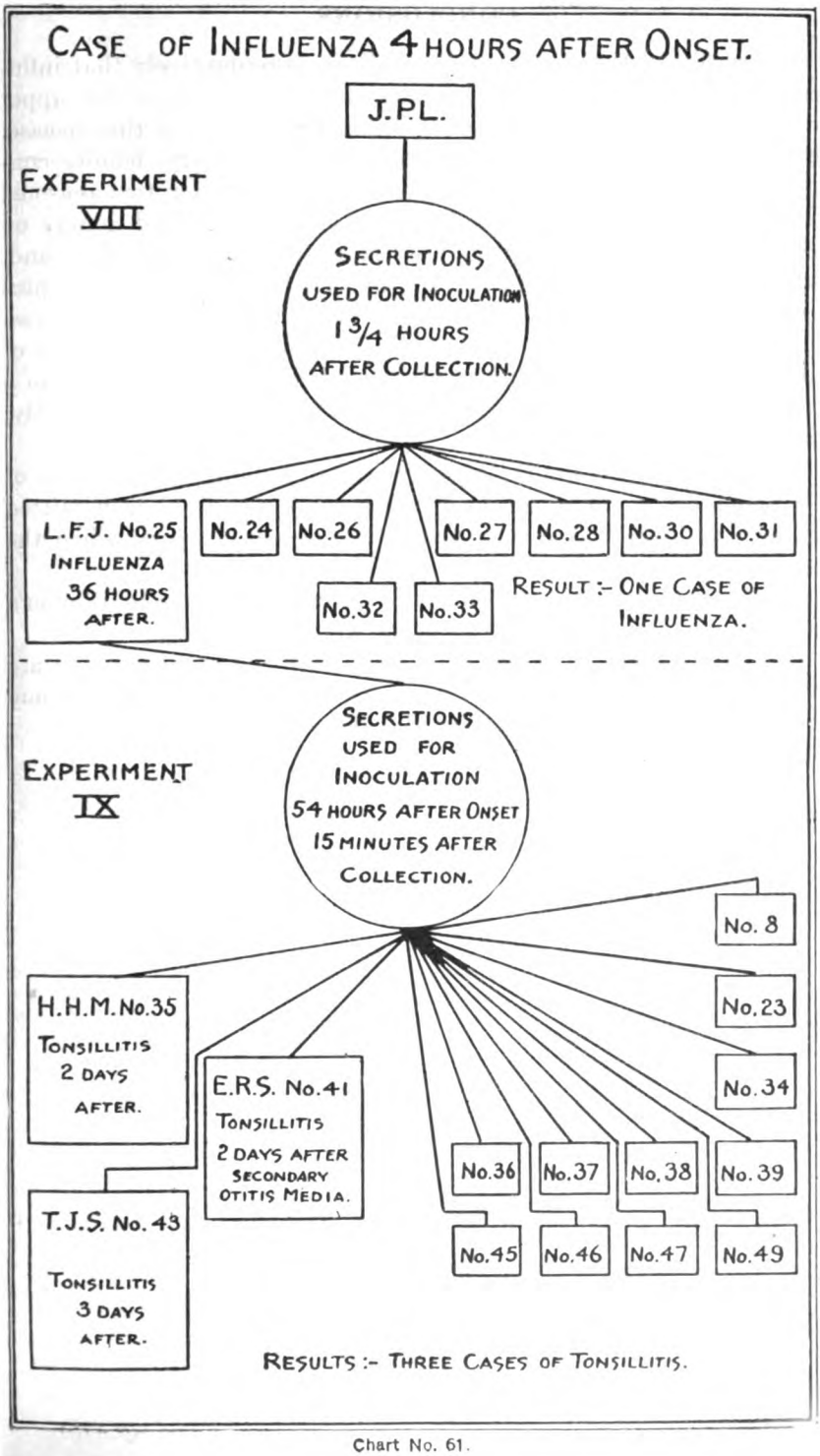

Chart No. 61.

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CONCLUSIONS.

The results of these experiments indicate presumptively that influenza may be transmitted by means of the secretions of the upper respiratory passages from patients in the early stages of this disease, probably within less than 12 hours from onset. Very definite conclusions can not be drawn from our experiments for two reasons: First, the uncertainty of our diagnosis in recipients and donors on account of the lack of decisive criteria as to what is influenza, and, second, the clouding of our results by the transmission of streptococcic tonsillitis to many of our volunteers. The apparently successful transmission of influenza occurred in only a small percentage of the instances attempted, the recipients being young male adults in a region where epidemic influenza had recently prevailed, and possibly, therefore, of more than average resistance.

In contrast to the difficulty in transmitting influenza by means of secretions, acute streptococcic tonsillitis may readily be transmitted in this way, and with a high percentage of success, even when the donor is apparently merely a carrier of the streptococcus.

Attempts to transmit influenza by means of cultures of Pfeiffer's bacillus and of Mather's streptococcus were unsuccessful.

Pfeiffer's bacillus is found in the throats of many people who are free from influenza, but shows a tendency to multiply and become predominant during an attack of the disease.

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TABLE I.—*Volunteers, Boston experiments, January and February, 1919.*

No.	Name.	Age.	History referable to recent pandemic.				Weight.		No. of experiments used in.	Remarks.	Illness caused by experiment.	Schick test (read in 72 hours)
			Previous attacks of influenza.	Close contact.	Casual contact.	No exposure.	Before experiment.	After experiment.				
							Pounds.	*Pounds.*				
1	Alberts, H.	21	0	+	−	−	143	142	1 and 5.		Tonsillitis.	0
2	Belcher, H. A.	27	0	+	−	−	142	144	1 and 5.		0	++
3	Bentley, F. E.	22	0	+	−	−	144	142	1 and 5.		0	++
5	Bolle, F. W.	23	0	−	−	+	170	172	2 and 9.		Influenza (?)	0
6	Brown, Wm. R.	29	0	+	−	−	158	158	1		0	0
7	Burns, Wm. S.	24	0	−	+	−	155	156	1 and 5.		Tonsillitis.	+
8	Caine, S. H.	30	0	−	−	+	172	172	1,6,and 9		0	++
9	Call, G. W.	27	0	−	−	+	147	143	1 and 7.		Tonsillitis.	Pseudo.
10	Cataldo, C.	21	0	+	−	−	135	127	1 and 7.		0	+
11	Clancy, R. R.	19	0	−	+	−	138	143	2 and 7.		0	0
13	Corbett, Hawley	26	0	−	+	−	156	160	2 and 9.		0	0
14	Corbett, J. J.	22	0	+	−	−	137	132	2	Tachycardia	Tonsillitis.	0
15	Corbett, J. L.	20	0	−	+	−	135	134	1 and 7.		do	0
16	Daniels, E. W.	21	0	−	+	−	159	159	2 and 7.		do	Pseudo.
17	Deming, C.	21	0	−	+	−	165	165	2 and 7.		do	+
18	Erwin, F. K.	24	0	−	−	+	162	.....	.....	Possible attack of influenza before experiment.	Not used in experiment.	0
19	Fox, J. J.	21	0	−	+	−	145	145	2		0	0
20	Greatrix, G. A.	23	0	−	+	−	142	142	2 and 7.		0	0
21	Harmon, R. A.	22	0	+	−	−	150	150	2 and 7.		Tonsillitis.	0
22	Hill, F. A.	22	0	−	−	+	152	145	3		do	++++
23	Hummel, P. F., jr.	19	0	+	−	−	182	184	4 and 9.		0	0
24	Isaacson, J.	36	[1] I	−	−	−	140	146	3 and 8.		0	0
25	Jankowski, L. F.	20	0	−	−	+	133	140	3 and 8.		Influenza	0
26	Kaplan, Louis	21	0	−	−	+	152	152	3 and 8.		0	0
27	Killebrew, Otis	26	0	−	−	+	165	166	3 and 8.		0	+
28	Kronberg, E. G.	21	0	−	−	+	165	176	3 and 8.		0	+
30	Louden, A. A.	22	0	+	−	−	165	153	3 and 8.	Faint mitral murmur	0	0
31	Maddox, A. W.	33	0	−	−	+	155	166	3 and 8.		0	0
32	Matthews, A. J.	21	0	−	−	+	165	164	3 and 8.		0	0
33	Mercurio, J.	21	0	−	+	−	156	152	3 and 8.	Contact control in experiment No. 3.	0	0
34	Moor, H. W.	20	0	−	−	+	155	158	4 and 9.		0	0
35	Mulvey, H. H.	23	0	+	−	−	151	148	4 and 9.	Influenza vaccine, September, 1918.	Tonsillitis.	0
36	McKeefrey, A. W.	22	0	−	−	+	168	174	6 and 9.		0	0

[1] Sept. 18, 1918.

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TABLE I.—*Volunteers, Boston experiments, January and February, 1919*—Continued.

	Name.	Age.	History referable to recent pandemic.				Weight.		No. of experiments, used in.	Remarks.	Illness caused by experiments.	Schick test (read in 72 hours).
			Previous attacks of influenza.	Close contact.	Casual contact.	No exposure.	Before experiment.	After experiment.				
							Pounds.	*Pounds.*				
	Searey, J. J.	25	0	—	—	+	148	142	6 and 9.		0	0
38	O'Hara, T. F.	23	0	—	+	—	137	146	4 and 9.		0	+
39	Reidy, W. D.	26	0	+	—	—	161	169	4 and 9.		0	+
40	Roe, E. F.	22	[2] I?	—	—	—	180	180	2.		0	0
41	Sanford, E. R.	25	0	—	—	+	143	140	4 and 9.	One dose influenza vaccine in July.	Tonsillitis.	++
42	Sliney, P. J.	21	0	—	+	—	140	135	1 and 7.		Influenza.	0
43	Smith, T. J.	24	0	—	+	—	152	147	6 and 9.		Tonsillitis.	0
45	Sullivan, D. J.	21	0	—	+	—	132	137	4 and 9.		0	++++
46	Taylor, H.	20	0	—	—	+	125	118	4 and 9.		0	+
47	Tully, A. P.	26	0	—	—	+	165	176	4 and 9.		0	0
49	Wright, H. D.	26	0	—	—	+	153	154	4 and 9.		0	++

[2] Oct. 20, 1918.

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symptoms noted d
bservation.
h man drank 60 c. c
50 c. c. milk.

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sillitis, acute follicul
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20 left island at end
s. 10,11,13 showed no

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5 (F. W. B.) was n
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HYGIENIC LABORATORY BULLETINS OF THE PUBLIC HEALTH SERVICE.

The Hygienic Laboratory was established in New York, at the Marine Hospital on Staten Island, August, 1887. It was transferred to Washington, with quarters in the Butler Building, June 11, 1891, and a new laboratory building, located in Washington, was authorized by act of Congress March 3, 1901.

Of the bulletins published by the laboratory since its establishment, copies of the following are available for distribution and may be obtained without cost by applying to the Surgeon General, United States Public Health Service, Washington, D. C.:

No. 2.—Formalin disinfection of baggage without apparatus. By M. J. Rosenau.

No. 43.—The standardization of tetanus antitoxin (an American unit established under authority of the act of July 1, 1902). By M. J. Rosenau and John F. Anderson.

No. 50.—Further studies upon the phenomena of anaphylaxis. By M. J. Rosenau and John F. Anderson.

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No. 87.—Digest of comments on the Pharmacopœia of the United States of America (eighth decennial revision) and on the National Formulary (third edition) for the calendar year ending December 31, 1911. By Murray Galt Motter and Martin I. Wilbert.

No. 89.—Sewage pollution of interstate and international waters with special reference to the spread of typhoid fever. VI. The Missouri River from Sioux City to its mouth. By Allan J. McLaughlin.

No. 94.—I. Collected studies on the insect transmission of *Trypanosoma evansi*. By M. Bruin Mitzmain. II. Summary of experiments in the transmission of anthrax by biting flies. By M. Bruin Mitzmain.

No. 95.—Laboratory studies on tetanus. By Edward Francis.

No. 96.—1. Report of investigation of coastal waters in the vicinity of Gulfport and Biloxi, Miss., with special reference to the pollution of shellfish. By R. H. Creel. 2. A comparison of methods for the determination of oxygen in waters in presence of nitrite. By Elias Elvove. 3. Some new compounds of the choline type. III. Including preparation of monoacetate of *a*, *B* dioxy-*B*-methyl butane. By

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No. 120.—1. The experimental production of pellagra in human subjects by means of diet. By Joseph Goldberger and G. A. Wheeler. 2. The pellagra-producing diet. By M. X. Sullivan and K. K. Jones. 3. Biological study of a diet resembling the Rankin farm diet. By M. X. Sullivan. 4. Feeding experiments with the Franklin farm pellagra-producing diet. By M. X. Sullivan.

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No. 122.—I. Deterioration of typhoid vaccine. By G. W. McCoy and Ida A. Bengtson. II. Standardization of gas gangrene antitoxin. By Ida A. Bengtson. III. Potency of bacterial vaccines suspended in oil (lipovaccines). By Ida A. Bengtson.

No. 123.—Experiments upon volunteers to determine the cause and mode of spread of influenza [for November and December, 1918, and February and March, 1919, at San Francisco and Boston. Three papers]. By M. J. Rosenau, W. J. Keegan, De Wayne Richey, Joseph Goldberger, G. W. McCoy, J. P. Leake, and G. C. Lake.

No. 124—I. Differentiation between various strains of meningococci by means of the agglutination and the absorption of the agglutinins tests. By C. T. Butterfield and M. H. Neill. II. The tropin reactions of antimeningococcus serums. By Alice C. Evans. III. Effect of freezing and thawing upon the antibody content of antimeningococcus serum. By C. T. Butterfield. IV. The fermentation reactions and pigment production of certain meningococci. By Clara E. Taft. V. Studies on the lethal action of some meningococci on mice with special reference to the protective properties of antimeningococcus serum. By M. H. Neill and Clara E. Taft.

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TREASURY DEPARTMENT
UNITED STATES PUBLIC HEALTH SERVICE

HYGIENIC LABORATORY—BULLETIN No. 124
NOVEMBER, 1920

I. Differentiation Between Various Strains of Meningococci by Means of the Agglutination and the Absorption of the Agglutinins Tests

By C. T. BUTTERFIELD and M. H. NEILL

II. The Tropin Reactions of Antimeningococcus Serum

By ALICE C. EVANS

III. Effect of Freezing and Thawing Upon the Antibody Content of Antimeningococcus Serum

By C. T. BUTTERFIELD

IV. The Fermentation Reactions and Pigment Production of Certain Meningococci

By CLARA E. TAFT

V. Studies on the Lethal Action of Some Meningococci on Mice with Special Reference to the Protective Properties of Antimeningococcus Serum

By M. H. NEILL and CLARA E. TAFT

WASHINGTON
GOVERNMENT PRINTING OFFICE
1920

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United States Public Health Service.

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CONTENTS.

	Page.
I. Differentiation between various strains of meningococci by means of the agglutination and the absorption of agglutinins tests	9
Introduction	9
Stock cultures	10
Preparation of antiserum	10
Preparation and standardization of the antigen for agglutination	11
Effect of varying the turbidity of an antigen	12
Simple agglutination test	12
The absorption of agglutinin test	12
Changes in type	18
Complement fixation, tropin and agglutinin tests on monovalent serums	21
Comparison of classifications	24
Selection of representative strains	25
Summary and conclusions	26
Bibliography	27
II. The tropin reactions of antimeningococcus serum	43
Definition of terms	43
Historical review	43
The usefulness of the phagocytic test	44
Description of methods	45
Obtaining the leucocytes	47
Order of procedure in making the tests	49
Interpretation of results	50
Method of production of immune serum	51
The problem of the classification of the phagocytic antibodies of antimeningococcus serum as serum opsonins or tropins	52
The effect of low dilutions of serum on phagocytic reactions	53
Details concerning the strains used in this study	54
Susceptibility of meningococci to phagocytosis	55
The tropinogenic power of meningococci	56
Specificity of tropin reactions	56
Tropin absorption tests	57
Classification of meningococci according to their tropin reactions	58
The tropin reactfon within the animal body	62
Comparison of the development of the agglutinins and tropins in the serum of immunized rabbits	33
The loss of tropinogenic power of the meningococcus, and the loss of power to react with specific tropins	65
The tropin content of commercial antimeningococcus serums	69
The deterioration of tropins in antimeningococcus serum	71
The problem of the identity of agglutinins and tropins	72
Discussion of the measurement of the therapeutic value of antimeningococcus serum by the tropin test	72
Summary	73
Bibliography	74

Digitized by Google

III. Effect of freezing and thawing upon the antibody content of a
ingococcus serum.....
IV. The fermentation reactions and pigment production of certain menii
Fermentation reactions.....
Pigment production.....
Bibliography.....
V. Studies on the lethal action of some meningococci on mice with
reference to the protective properties of antimeningococcus ser
Introduction.....
Protection tests with live cultures.....
Attempts to raise virulence by animal passage.....
Comparison of lethal effect of living and dead cultures.....
Lethal properties of dead meningococci.....
Low killing power of meningococcus "Endotoxin".....
Protection of mice by antimeningococcus serum.....
Bibliography.....

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LIST OF ILLUSTRATIONS.

	Page.
Paper No. I:	
Chart 1. Simple agglutination reactions, 1918 work	42
Chart 2. Absorption agglutinins, 1918 work	42
Chart 3. Simple agglutination reactions, 1919 work	42
Chart 4. Absorption of agglutinins, 1919 work	42
Paper No. II:	
Fig. 1. Phagocytosis of meningococci after treatment with immune serum	74
Fig. 2. Agglutination of meningococci without phagocytosis	74
Chart 1. Relationship between the agglutination types and the tropin groups	85
Chart 2. Development of the agglutinins and tropins in the serum of immunized rabbits	86
Chart 3. Relationship between the tropins and agglutinins in 128 commercial serums	87

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I. DIFFERENTIATION BETWEEN VARIOUS STRAINS OF MENINGOCOCCI BY MEANS OF THE AGGLUTINATION AND THE ABSORPTION OF AGGLUTININS TESTS.[1]

By C. T. Butterfield, Sanitary Bacteriologist, United States Public Health Service, M. H. Neill, Passed Assistant Surgeon, United States Public Health Service.

This report is based on a study of 101 meningococcus cultures. Practically all of them were isolated within the United States. Only spinal fluid cultures secured from cases which presented the clinical features of cerebrospinal fever were used. Throat cultures or strains from unreliable sources were not employed. The study deals particularly with the agglutination reaction, the absorption of agglutinins test, and a comparison of the relative value of the two tests. However, some kindred problems which came up during the progress of the work are discussed in so far as they were touched upon. These kindred problems are, namely, the standardization of antigens for the agglutination test, the relationship existing in monovalent serums between the complement fixation, the tropin and the agglutination tests, the classification of the same organisms by different workers, and the variation in the types of the meningococcus secured from cases occurring within a given geographical location. Table I, giving all the details in the history of the cultures, has been provided for those who might wish information regarding them. A similar table, Table IX, has been provided, giving the history of cultures which have come into the laboratory since the work was started. These latter cultures have been typed only and have not been extensively studied.

It is not the purpose of this investigation to establish a new classification of the meningococci, but to determine, if possible, how definitely the strains of American meningococci, on hand here, fall in with the types already established. Free reference has been made to the research work of both English and French workers, particular attention being given to Dopter's and to Gordon's classifications. Our results have in general been in accord with the results obtained by these two workers. Our methods, with some modification, have been similar to those used by Col. Gordon and his coworkers.

[1] Submitted for publication. Feb. 7, 1920.

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STOCK CULTURES.

The stock cultures were kept on ordinary infusion agar, reaction pH 7.4 to 7.6 when compared with the hydrogen ion standards. The addition of 5 per cent of normal horse serum, 1 per cent of dextrose, and 0.5 per cent of dipotassium phosphate always produces a better growth and is essential with freshly isolated cultures. The serum and the sugar solution are added to the medium after its preparation has been otherwise completed and after its final sterilization. The culture tubes, after inoculation, are sealed and kept at 37° C., as nearly as possible in a saturated atmosphere.

The method of inoculation and the surface condition of the medium exert considerable influence upon the longevity of the culture. In this procedure, as well as in the making of the medium, the procedure of Nicolle (1918) was followed rather closely.

PREPARATION OF ANTISERUM.

All of the antiserums used were prepared from rabbits. Fowls were tried for this work and they yielded a satisfactory serum; but only after weekly injections extending over a long period of time, four to six months. The rabbits yielded satisfactory serum as a rule within from two to three weeks after the first injection.

The usual procedure was to give each rabbit an intravenous injection on each of three consecutive days, let the animal rest three to four days, repeat the three injections, and then another repetition of the inoculations, after a three to four days' further rest. A test bleeding was made from the ear, four or five days after the last inoculation. If this test bleeding showed a satisfactory titer (1–800 or better) for the homologous coccus, the rabbit was bled from the heart the following day. After the serum had been separated from the clot and cleared by centrifuging and pouring off, it was preserved by adding 0.25 of 1 per cent of tricresol.

This procedure was the most satisfactory of a number tried, and seldom failed to give a good result. The amount of the initial dose of culture is of course governed by the toxicity of the particular strain used. Usually one-half to one billion cocci in 1 c. c. of salt solution are sufficient for the initial dose. As a rule the dose can be decidedly increased at the beginning of each set of inoculations. Live organisms, in an emulsion in normal saline, were used for injection in preference to killed cultures. The live cultures were found to be much less toxic than those which had been killed. The agglutinogenic properties of the live and killed emulsions seemed to be about the same. The inoculations were always made as soon as possible after the emulsions were prepared, with the object of avoiding undue autolysis. [illegible] reason, young, lightweight rabbits seemed to give better

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results and to be less susceptible to the toxic properties of the organism than were the older, heavier rabbits.

PREPARATION AND STANDARDIZATION OF THE ANTIGEN FOR AGGLUTINATION.

Various methods of preparing and standardizing the antigen were tried. The one found most satisfactory is described below.

The standard stock culture agar was the medium used for securing the growths, with the exception that the 5 per cent of serum was not added to the medium. The medium was poured in ordinary wide mouth, pint Blake bottles. The sterile Blake bottles were warmed in the incubator and seeded with a meningococcus emulsion, made by washing the growth from an 18-hour slant culture with about 5 c. c. of sterile broth. This made sufficient emulsion to seed two Blake bottles. The emulsion was washed evenly over the surface of the medium and allowed to stand on it from 2 to 3 hours; the bottles were then inverted and incubated overnight (about 18 hours). Before removing the growth from the bottles with a sterile pipette all condensation water and emulsion used for seeding were carefully removed by the use of a sterile pipette. The growth was then washed off in as small an amount as possible of normal saline and immediately killed by heating to 65° C. for one hour. Rapid killing is necessary in order to prevent autolysis resulting from enzyme action, as has been observed by Flexner (1907).

The most satisfactory method of standardizing the antigen was found to be the determination of its turbidity, by comparing it by means of dilutions with a silica standard of known turbidity, as described in the Standard Methods of Water Analysis of the American Public Health Association for 1917.

Using this method and the nephelometer (or other standard methods of determining turbidity) antigens can be made easily whose turbidity will vary not more than 10 per cent. Such a low variation is not sufficient to affect appreciably the results obtained.

For our work an antigen of a turbidity of 1,000 parts per million (i. e., 500 parts per million when it has been further diluted by the addition of the diluted antiserum in the agglutination tube), was found to be the most satisfactory. With such a turbidity, the agglutination action can be readily determined by the naked eye, and there is no occasion for indeterminate readings.

It was found after painstaking determinations that a suspension of organisms with a turbidity of 500 parts per million, in terms of the silica standard, contained about one billion meningococci per c. c. After heating the antigen it was diluted with normal saline, to which one-half of 1 per cent of phenol had been added, until the dilution

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desired had been obtained. Where possible stock anti
made in sufficient quantity to last through the entire series
ments. Gram stained preparations were made of the antig
they were used and frequently afterwards, and examine
phology and staining characteristics to determine their p

Occasionally, antigens were found which agglutinat
In such cases the preparation of new antigens from the sa
usually yielded good results. Control determinations w
made to cover any possible error due to antigens.

EFFECT OF VARYING THE TURBIDITY OF AN ANTIG

A series of preliminary tests had indicated the necessity
throughout only those antigens which had a fairly uniform
The antigens for these tests were prepared according to th
procedure described. The antiserums used for these tests
the stock polyvalent serums on hand, or some of the n
serums used in the later experiments.

Dilutions of the serum used, of from 1–25 to 1–6,400, we
all cases, 100 per cent difference being made between eac
The variation in the turbidities was made to run from 2
parts per million; this, too, being varied in steps of 10
difference in each case. The tabulated results are shown i

In general it can be said that an increase of 100 per
turbidity of the antigen will lower the titer of the serum 5
Results of agglutination tests can be made comparative
only when a standard turbidity, for the antigens used, is

SIMPLE AGGLUTINATION TEST.

Antigens prepared from all the strains tested were set
each serum; first in a simple agglutination test, and
antigens which agglutinated in titers of at least 1 to 1
were used to saturate this serum in the subsequent abso
If the titer of the monovalent serum was over 1 to 400 for t
gous coccus, one-fourth of this titer was used as a standar

In the simple agglutination test six agglutination tub
up for each antigen. Into each of these in order was pla
1–50, 1–100, 1–200, and a 1–400 dilution of the antiserum
into the sixth tube a 1–25 dilution of a pooled normal ra
The dilutions were made up in such quantities that ½ c. c.
to each tube. One-half c. c. of the standard antigen was
to each of the 6 tubes, thus making the resultant dilut
antiserum 1–50, 1–100, 1–200, 1–400, 1–800, respectively,
normal [illegible]m, 1–50, and the final turbidity of the mixtur
per [illegible]he tubes were then shaken thoroughly t

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perfect admixture of serum and antigen. The incubation period was overnight at 56° C. followed by 4 to 6 hours' storage the following day at 15° C., before the final reading. A very few of the cultures showed a slight precipitation with the normal serum. Practically all cultures however, showed a perfect control, i. e., no precipitation in the tubes containing normal serum.

To avoid fictitious accuracy, and to standardize the comparative results, only three grades of agglutination were recognized; +, ±, and −; + indicating an agglutination where there was a flocculent precipitate with a clear, or practically clear, supernatant fluid; ± showed indications of some agglutination, but with a somewhat turbid supernatant; − indicated an entire lack of agglutination. In recording results, making absorptions, and drawing conclusions, only the + agglutination was considered. It was thought that by this method the errors due to the reading by different workers and the exaggerated exactness of finer readings would be eliminated. This was found to be true. It may be that in determining the comparative titers of serums, a lower turbidity of antigen or a finer gradation of the reading of agglutinations is desirable; but, for the classification of an organism along with certain other strains, the method described presents fewer opportunities for experimental errors.

THE ABSORPTION OF AGGLUTININ TEST.

In selecting agglutinable organisms for saturation, only those antigens were selected which agglutinated in at least one-quarter the titer of the particular serum for its homologous coccus, with the exception that agglutination in titers below 1–100 was not considered as sufficiently indicative to warrant the application of the absorption test. In numerous cases, where strains were being tested, which it was thought might be represented in the serum that was under examination, absorption tests were made with antigens which either did not agglutinate at all or else only in a 1–50 titer. In no instance was it found that such an organism absorbed sufficient agglutinins to be indicative. Our experience has been that a meningococcus which does not agglutinate with a serum will not absorb agglutinins from that serum.

The amount of coccus emulsion required to saturate a given serum varies with the organism used and with the serum upon which saturation is attempted. It was found in this work, with the strains and serums used, that usually 3.2 c. c. of the standard antigen added to 0.8 c. c. of a 1–10 dilution of the serum were sufficient for complete saturation. This mixture contained a sufficient quantity of diluted serum (1–50 dilution) to set up an absorption test. The technique of the absorption test is most readily explained by refer-

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ring to Table A, showing the complete absorption of a
from serum 136 for coccus 136 by antigen made from co
and the lack of absorption by coccus 137.

TABLE A.—*Showing procedure followed in the absorption of agglutinins ration of serum 136 with its own antigen as a control and with Antigens as the strains being tested.*

A	B	I			II			III		
Cocci used for antigeus in columns B, I, III, and C.	Preliminary absorption for 24 hours at 37° C.; the amount of agglutination is recorded.	Control 1: Serum unsaturated; otherwise treated the same as that in II and III; set up against coccus as indicated in column A.			Test: Serum first saturated with coccus indicated in column A; then set up against coccus 136; the amount of agglutination is recorded.			Control 2: Serum f saturated with c cus indicated in umn A; then set against same coc to see if saturat was complet amount of agglut tion is recorded.		
		Dilution of serum.			Dilution of serum.			Dilution of serum		
		1–100	1–200	1–400	1–100	1–200	1–400	1–100	1–200	1–
136.....	+	+	+	+	−	−	−	−	−	-
133.....	+	+	+	±	−	−	−	−	−	-
137.....	+	+	+	−	+	+	±	−	−	-

In making the test indicated in Table A, 4 centrifuge used. In tube No. 1 monovalent serum 136 (1–50 dilution) in sufficient amount to set up the agglutinations indicate umn I. In each of the other 3 tubes, numbers 2, 3, and 4 portions of a 1–10 dilution of serum 136 are placed. Then tube, 3.2 c. c. of 136 standard antigen are added; to No 3.2 c. c. of standard antigen 133; and to No. 4 tube, 3.2 standard antigen 137. All 4 tubes are then incubated for at 37° C. (Other methods of incubation for different pe at different temperatures were tried, but this was found satisfactory.) The extent of the agglutination is then re column B of the table. The tubes are then centrifuged fo utes at high speed, to throw down not only the agglutina but also those which have not been affected by the a This should leave a perfectly clear supernatant fluid.

The supernatant fluid from tube No. 1 is used to mak dilutions for column I; the supernatant from tube No. 2 the antiserum for the 136 row of columns II and III; the tant of tube No. 3 likewise is the antiserum used in the 1 columns II and III, and tube No. 4's supernatant is use dilutions of the 137 row of columns II and III.

One-half c. c. of standard antigen 136 is now added to all n II; then to the tubes of each row of columns I f standard antigen, according to the numbers sponding row of column A. The tubes are the

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and given the same incubation before reading, as is given in the simple agglutination test.

Thus, column I's reactions become a control on the effect of the period of incubation upon the serum being tested; column III's reactions become a control of the saturation itself, indicating whether the organism used for saturation has absorbed all of its own agglutinins or not; and column II's reaction is the crucial one, indicating whether or not the saturating organism has removed the agglutinins of serum 136 for its homologous coccus.

In these absorption tests, to qualify as a member of a type, the coccus tested was required to react as follows:

1. It must remove all or practically all of its own agglutinins from the type serum, i. e., the saturation must be complete.

2. After it has acted on the type serum, the titer of the type serum for its homologous type coccus must be reduced at least one-half, as compared with the unsaturated control agglutination test, column I, done at the same time and subject to the same conditions.

3. The organism must not agglutinate with the normal serum.

Considering these conditions and according to the results indicated in the table, coccus 133 is directly related to 136, or is of the same type; while coccus 137 is not directly related to strain 136.

During the course of the work approximately 2,000 simple agglutinations, necessitating the making of 750 absorption tests, were done. They were all done by the same standard technique described in the above methods.

The work as a whole was divided into two parts; that accomplished in 1918 and that done in 1919. The first part consisted of a standardization of the methods previously described and the attempted typing of the strains on hand. The results of the 1918 investigation are recorded in Table IV and are graphically represented in Charts I and II. The antigens and the serums in Tables IV and V and in Charts I, II, III, and IV are arranged according to the types in numerical order within each type. This was arranged to make the tables and charts more readable.

In the 1919 work 14 representative cultures were selected from the stock used in 1918. Three different antiserums were prepared for each of these strains. The agglutination and the absorption reactions of each of these serums were tried against antigens prepared from each of the 14 selected strains. The reason for using these separate serums prepared from different rabbits was that it had been suggested that perhaps there would be differences in the serums, especially as to specificity prepared from different rabbits. Each of the three type serums was therefore run against the few selected antigens from each type. This gave a very satisfactory control on the specificity of serums obtained from individual rabbits. The results of the 1919 work are

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recorded in Table V and are graphically represented in Char IV. In Table V and Charts III and IV where there are thr of the same number they are arranged in the same alphabet as they are in Table VII. The letter in each case refers to t from which the serum was obtained.

Referring to these charts, it is readily seen from Chart III antiserums prepared from different rabbits apparently sh differences in specificity. However, when the correctior absorption test is applied, Chart IV, these differences are r five.

One serum, 56, fails to agglutinate antigen 64; one serum not agglutinate antigen 55; one serum, 106, fails to ag antigen 50; two serums, 110, fail to agglutinate antigen 50, serum, 138, fails to agglutinate antigen 135. It is seen that of these variations occur in Type III. (The relationship of c to Type III is discussed later.) There are, to be sure, ma differences between the serums but they are differences that c in the nonspecific antibodies.

A careful study of Tables I and IX shows that the men isolated from the cases occurring in a given geographical are all of one type. On the contrary there are instances wh sentatives of at least three of the types have been isolated w confines of one locality. A classification of these organisms to their geographical location is not practicable.

Fortunately, strains 135, 136, 57 and 138, representing Col. four types, were available at the start of the 1918 work and m antiserums were prepared from each of them. The classificat Hygienic Laboratory strains with these serums according to th nation and the absorption tests is recorded in Table III liminary division of the strains into provisional types pr more satisfactory method of selecting strains for future wor the tabulation of results.

In order to check up our results with those of Gordon, stan pensions of a number of strains were sent to Col. Gordon at th Cerebrospinal Fever Laboratory in England and we acknowl heartily his kindness in making the type determinations strains. He was unaware of our results when the deter were made. Following are his results using simple agglutina and absorption tests.

Hygienic Laboratory strains:

No. 98, Type I, by absorption test.
No. 115, Type I, by absorption test.
No. 123, Type I, by absorption test.
No. 56, Type II, by absorption test.
No. 58, Type II, by absorption test.

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No. 60, Type II, by simple agglutination test.
(Absorption tests negative for Type II.)
No. 57, Type III, by simple agglutination test.
No. 106, Type III, by absorption test.
No. 116, Type IV, by simple agglutination test.

NOTE.—Organisms submitted to simple agglutination test only were agglutinated by none of the type serums except the one noted. The absorption test using No. III serum was not done on suspension No. 98 although No. III serum agglutinated it weakly.

In the 1918 work antiserums were prepared for the following strains: 6, 10, 11, 12, 50, 51, 55, 56, 57, 60, 98, 135, 136, and 138. Each of these serums was tried out against all of the antigens with the following results:

Serum 135 agglutinated, in dilutions of 1–100 or higher, 40 of the 45 strains which were later classed as Type I. It also agglutinated 7 out of 23 strains later classed as Type III, and 6 out of 27 later classed as Type II.

Serum 136 agglutinated 26 of the 27 strains later classed as Type II, also bringing down 3 out of 23 strains later typed as III's.

Serum 57 agglutinated 23 out of 23 strains later classified as Type III, 1 out of 45 strains later classed as I, and 1 strain 134, which later was found to belong equally to Type III or IV.

Serum 138 brought down 3 out of 3 strains later classed as IV's, also agglutinating 5 out of 27 strains later classed as Type II, and 3 out of 23 strains later classed as Type III.

With this preliminary division in mind, the other serums which had been made were set up against all of the antigens, with the following results:

Serum 10 agglutinated 39 out of 45 I's, 2 out of 27 II's, and 2 out of 23 III's.

Serum 11 agglutinated 36 of 45 I's, 1 of 27 II's, and 2 out of 23 III's.

Serum 12 agglutinated 39 of 45 I's, 1 of 27 II's, and 9 out of 23 III's.

Serum 50 agglutinated 39 of 45 I's and 6 of 23 III's.

Serum 51 agglutinated 38 out of 45 I's and 4 out of 23 III's.

Serum 98 agglutinated 35 out of 45 I's, 22 of 27 III's, and 1 of 3 IV's.

Serum 55 agglutinated 27 out of 27 II's, 1 of 45 I's, and 1 of 3 IV's.

Serum 56 agglutinated 21 out of 27 II's and 1 of 3 IV's.

Serum 6 agglutinated 21 out of 23 III's and 17 out of 45 I's.

Serum 60 agglutinated 1 out of 3 IV's and 4 out of 27 II's.

Judging from these preliminary results, it seemed that of the strains from which the serums were made 10, 11, 12, 50, 51, 98, and 135 could be considered as belonging to the same type; 55, 56, and 136 to another; 6 and 57 to a third; and 60 and 138 to a fourth.

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Using these serums the absorption test was applied to all which were agglutinated to determine how it correlated simple agglutination test. The results are recorded in T and Chart II.

These strains, 113, 116, and 174, were not affected by an serums tried. New antigens were tried repeatedly, with the lack of agglutinability might be due to a poor antigen, but tive result never was secured.

Strains 10, 128, 129, 149, 220, 222, and 227 were influenc few serums that their location in the types in which they ar is indicative of their possible typing more than their definit tion. With the exception of the three inagglutinable strai above, all of the Hygienic Laboratory cultures either fall in Gordon types or are rather closely related to some one of th

Certain strains, however, 10, 50, 98, 111, 131, and 134 broad in their agglutinating characteristics that they see closely related to two types; strains 10, 50, and 98 lo Type I are related also to Type III. This is particularly tr which absorbs agglutinins equally well from representative s each type. Strains 111 and 131 are in Type III, but they ar related to Type I, while 134 has characteristics indicating related to both Types III and IV.

CHANGES IN TYPE.

This leads to a discussion of the difficulties which were ex with strains 134 and 138. Early in the work culture received from Rockefeller Institute (originally from Dr. the New York City Department of Health), representing a of Gordon's Type IV. The work with this culture failed it definitely either in Types III or IV, as it gave equa agglutinations and absorptions for each type (see Table IV). ingly culture No. 138 was secured from Dr. Park direct. Thi when received in 1918 was a true Type IV. It showed agglutination reaction with two members of Type III, but n tion whatever was observed. However, when this work was in 1919 (see Table V) No. 138 had retained its Type IV aggl qualities, but in addition it had broadened and shows characteristic reactions for Type III strains which 134 di The explanation of this change is not apparent.

Four other strains worked with in 1919, Nos. 50, 64, 128, showed changes in type from that determined in 1918. shows coccus 50 to be a Type I in 1918, having absorption wit members of Types III. Table V and Charts IV be a typical Type III organism both in r

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simple agglutination and the absorption test. Strain 64 in 1918 was clearly indicated as belonging to Type III. In the 1919 work it does not react at all with Type III serums or antigens but is clearly indicated as being a member of Type II. Strain 128, while it was never definitely placed, was in 1918 apparently related to Type I, while in 1919 it reacts only with Type IV serum. Strain 135 in 1918 had shown itself to be a very broad strain in its agglutinogenic properties, reacting with six Type II strains, seven Type III, in addition to bringing down 40 Type I strains. Previous to the beginning of the 1919 work, effort had been made to raise the virulence of 135 by mouse passage. Forty-six passages had been made. This passage strain was used first to immunize the rabbits, three antiserums being prepared. When these antiserums were tried out, 135 seemed to be a typical Type IV, as the serum agglutinated only the representative Type IV strains and these were the only strains which absorbed the homologous agglutinins from serum 135. Thinking that this change might be due to some change in the passage culture, recourse was had to the old stock culture, which had been carried in the meantime on the stock media entirely separate from the passage culture. It was a surprise to find that its antiserum and antigen reacted in much the same way as that made from the passage culture. The only relationship which the culture marked 135 now showed for its former Type I culture No. 135 was that its serum agglutinated antigens 11 and 12, Chart III. These antigens, however, failed to absorb any homologous agglutinins. This divergence from the 1918 culture was confirmed by the complement fixation test. The tropin test, however, detected no change in this culture or in the serum prepared from it. A searching criticism of our laboratory procedure indicated no reason for these changes.

A number of strains, see Table IX, which have accumulated since the major part of this work was started, were tested with the standard polyvalent and the selected monovalent serums with the results indicated. Several very interesting strains, 265, 286, 289, 300, and 305, from the standpoint of typing and the definition of a meningococcus form a part of this collection.

Strains 265 and 300 failed to agglutinate with any of the type serums. They were both agglutinated with the standard polyvalent serum. When the polyvalent serum was saturated with their antigens they absorbed its agglutinins for the Type II antigens only. This would indicate that these two strains probably belong to Type II. With the fixation test, however, both are indicated as belonging to Type I.

Strain 289 failed to react with either the polyvalent or monovalent serums by the agglutination test although different antigens were tried; antigen 289, however, fixed complement with Type IV serum.

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Strain 286 is agglutinated by the polyvalent serum and I and II serums. It absorbs the homologous agglutinins the Type II serum No. 56. Tested by the complemen reaction, its antigen fixes complement with the polyvalent s dilution of 1–2,000. Four monovalent serums 286 and one were tested by the fixation test against the standard antigen

The results of the complement fixation tests were recor form of a fraction comparing the height of titer in whic was complete in the serum undergoing test (numerator) obtained in using the polyvalent positive control serum (deno Both tests were made simultaneously against portions of antigen. To obtain the actual titers multiply both nume denominator by 100. Thus $\frac{2.5}{20}$ means that complete fixa place in a dilution of one part in 250 using the serum under while complete fixation occurred using a 1 in 2,000 dilut positive control serum. The controls usual in complemen tests were always used; these included a known negative or serum.

Serum 286 No. 1 with antigen 286 gave $\frac{2.5}{20}$.

Serum 286 No. 2 with antigen 286, $\frac{5}{10}$, with antigen 123, antigen 60, $\frac{2.5}{20}$.

Serum 286 No. 3 with antigen 286, $\frac{5}{20}$, with antigen 56, $\frac{2}{}$

Serum 286 No. 4 with antigen 286, $\frac{2.5}{20}$, with antigen 56,

Serum 56 with antigen 56, $\frac{20}{20}$, with antigen 286, $\frac{10}{20}$.

The agglutination and the fixation results indicate that is closely related to Type II.

Strain 305 presents a peculiar problem. It has many of acteristics of meningococci but in addition it has other which do not conform to the established definitions of a me cus. The strain was isolated from a spinal fluid which wa this laboratory. The physician sending the specimen r suspected case of cerebrospinal fever. (The patient died s The fluid was 48 hours in reaching the laboratory but the we very warm. The container in which the specimen was would have permitted of possible, but not probable, nati plating out the fluid on blood agar a gr ningococcilike colonies was obtained. I a nies on the plates were examined. T ing that the culture was pure. It was

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coccus, distinctly Gram negative but retaining the stain somewhat more tenaciously than the average meningococcus. The culture fermented maltose and glucose with acid production, but it did not affect saccharose. In fresh cultures many tetrads and "bizarre" forms were observed. It agglutinated completely in a $\frac{1}{400}$ dilution with the standard polyvalent serum. The complement fixation test with polyvalent serum was negative. It did not agglutinate with $\frac{1}{50}$ normal serum nor in salt solution. It agglutinated with Type I serum, 123, and absorbed a small percentage of agglutinins from the same. It did not agglutinate with the other type serums in significant dilutions. It went into emulsion in salt solution readily and smoothly. It grows much more readily and luxuriantly than any of the other cultures, forming a rich, creamlike growth $\frac{1}{16}$ to $\frac{1}{8}$ inch thick on the surface of a slant in 18 hours' time. It grows slowly but surely at 18 to 20° C. It produces after 48 hours a faint, but definite, yellowish pigment. It is much less toxic for rabbits than the average meningococcus, as rabbits will stand ten times an initial dose of No. 305 as compared with that of a culture of ordinary toxicity. When the routine procedure of injection of the rabbits was followed, agglutinins and fixation bodies were produced. These antibodies do not react with the Type I antigen, 123; however, they do agglutinate and fix complement with antigens 56 and 136, representing Type II. These facts, that agglutination of a meningococcus with serum of one type, and production of antibodies for an entirely different type, when the same organism is injected into rabbits, have been observed by Gibson and Ludlow (1919). The location of this organism as a meningococcus seems to be debatable.

COMPLEMENT FIXATION TROPIN AND AGGLUTININ TESTS OF MONOVALENT SERUMS.[2]

A brief study was made to determine the comparative relationship existing in the antiserums used, between the complement fixation bodies, the tropins, and the agglutinins. Table VI gives the compiled data.

The complement fixation tests were run in accordance with the (standard) method in use at the Hygienic Laboratory. Results were read by comparing tubes with standards of different degrees of hemolysis. A fixation of "3" was considered significant for this work. In order to give a correct impression of the complement fixation titer of each serum, the titer of the control serum for each antigen is given along with the titer of the test serum. The titer of the serum undergoing test is shown as the numerator of the fraction in the table and the titer of the control serum as the denominator.

[2] We acknowledge our indebtedness for the performance of the complement fixation tests to Mr. H. B. Corbitt and for the tropin tests to Miss A. C. Evans.

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To secure simplicity of notation the titers are all r
1–100 of the titer in which complete fixation was actual
At the bottom of the table the agglutination titer of th
control serum is shown, for each antigen. In some instan
show fixation in one-eighth, or less, of the dilution sho
control serum. It is believed that complement fixatio
this quantity have no specific significance.

The Type I serums tested were made from strains 11, 2
The serums of this type uniformly contained nonspecific
which fixed complement with the antigens of Type III.
11 gives fixation, but not agglutination, with antigen 57
fixation and agglutination with antigen 110. Serum 12
gens 50 and 57 without a corresponding agglutination.
showed agglutinins for strains 110, 106, and 57 and c
fixation bodies for strains 106 and 57; strain 110 was
With the strains in this type, both the fixation and the ag
reactions are specific.

The Type II serums tested, with the exception of one No.
reactions with the antigens of either Types I, III, or IV.
tion, in the case of one serum, 55, may be disregarded as
since the control serum gave fixation in eight times th
However, serum 136 did give agglutination with Type I
in two out of three cases. The absorption of agglutinins
ever, did not confirm this reaction.

In the specific reactions of Type II by the compleme
test, serums 56, 64, and 136 do not effect antigen 55. Howe
55 does show antibodies for antigens 56 and 136, and as a
shown in a higher dilution than for its own antigen. Th
are paralleled by the agglutination test, with one excep
of the three No. 56 serums gave agglutination in the 1–100 di
antigen 55. Antigen 55, however, failed to absorb the h
agglutinins for antigen 56. This would indicate that s
different from the other members of this type.

The nonspecific reactions of the Type III serums teste
the fixation of complement with antigens of Type I. Ty
to be closely related to Type III, as was shown by the
tained with the Type I serums. Moreover, in the non
sults with Type I antigens, one Type IV antigen, 138, ga
with 4 out of 5 serums tried. But, as has been noted ab
138 is related to Type III in its present reactions. In mos
the results of the agglutination tests parallel the fixation
tained. In the reactions with the antigens of the same t
sults obtained with the samples of Type III serums te
sp[illegible]y with each other.

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The Type IV serums tested gave nonspecific reactions in a few cases. One of the three, serum 60, gave a slight fixation reaction with antigen 55. Otherwise, the results with serum 60 were quite specific. No nonspecific agglutinins were found. Serum 135 gave occasional reactions with Types I and II antigens, but for the most part 135 appeared to be a pure Type IV in its fixation reactions. Serum 138 persistently showed the presence of antibodies for Type III antigens and its antigen reacted with the Type III serums. However, the serum 138 gave typical reactions with the Type IV antigens.

With but few exceptions the results of the complement fixation and the agglutination tests correspond. These exceptions occur principally in the nonspecific reactions and, usually, are observed only in high titer serums. In some serums, not included in the table, it was found that further injection of the rabbits, after they had been bled once, produced more nonspecific antibodies in the serum obtained from a subsequent bleeding.

When all three of the antibodies under discussion are found in a serum, the agglutinins are found only in lower dilutions and the tropins in still lower dilutions, in about the order of 1–2,000 for the fixation bodies, 1–800 for the agglutinins and 1–100 for the tropins.

Unfortunately it was not possible to have the tropin test performed on all antigens, but where it was done its close relationship evidenced to the other two tests is not so apparent. For instance the tropin test fails to differentiate between coccus 123 and coccus 57, representatives of Types I and III, respectively, and between 55 and 56, two somewhat different strains of Type II. For a further discussion of this matter see Miss Evans's paper on tropins in this bulletin, Table XII and Chart 1. The only difference between the complement fixation and the agglutination tests, other than the quantitative one mentioned, is that the complement fixation reaction seems to be more sensitive in indicating the presence of nonspecific antibodies in the type serum. Every antimeningococcus serum tested which was found to contain agglutinins also contained complement fixation bodies for the same type. The converse of this statement was also found to be true. Such a serum, however, did not necessarily contain tropins for any of the types. On the other hand, one serum was tested which had a high tropin content, positive reaction in a dilution of 1–300, and this serum did not show the presence of either of the other two antibodies.

Considering the results as a whole, it is apparent that the members of Types I and III, while they are distinct entities, are nevertheless closely related to each other. In applying a test of less specificity than the absorption of agglutinins test, considerable difficulty might be encountered in distinguishing between these two types. Al-

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though, in some instances, cross reactions are observed b members of Types II and IV, there is no such relation bet as there is between the other two types.

In conclusion, it can be said that, in the monoval tested, the agglutinins and the complement fixation bo correspond, the absorption of agglutinins test being the m No such close correspondence is observed with the tropin

COMPARISON OF CLASSIFICATIONS.

It is not desired that this be considered a new classifica meningococci. But it is hoped that, if this investigatio nothing else, it will result in the various investigators ha form nomenclature for their classifications, and that they when they are discussing the same type of organism. confusion has arisen over this is apparent when one reads ing opinions selected from the several publications, in v seems to be considerable confusion, even between the re classifications of the regular or normal meningococci an meningococci, and considers at the same time the data of

Dopter, 1918: Previous to the war the parameningococcus was rare; b war its prevalence increased to 45 per cent of cases.

Andrews, 1917: Dopter found that some of the parameningococci fron could not set up meningitis, and he found this type in sporadic ca Group I prefers maltose. It agrees in a general way with Gordon's Ty and with the meningococcus of Dopter. Griffith's Group II prefers glu sponds with Gordon's Types II and IV and with the parameningococ Griffith found representatives of Group I less numerous among the ph amongst the spinal strains. The bulk of the saprophytic meningococci c fall under Group II, though some are indeterminate.

Ellis, 1915: Our Type II is probably identical with the paramen Dopter.

Hiss and Zinsser, 1918: Dopter's parameningococcus, at first isolated throats, has since been found in the spinal fluid of cases of meningitis.

Stitt, 1919: Rockefeller Institute recognizes Dopter's two types and types. The English recognize 4 types, I, II, III, and IV. Type I Flexner's para strain and Type II to his normal one. Types III and IV

Flexner, 1917: The Type I of the English classification appears to cor para, and Type II to the normal or regular meningococcus.

Gordon, 1918: Type I apparently represents the normal meningococcu the parameningococcus.

The "meningococci" are classed by the English wo their general group or Type I, and the "parameningoc Type II; while the Rockefeller Institute classed the " gococci" with Type I and the "meningococci" with Type

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SELECTION OF REPRESENTATIVE STRAINS.

In selecting a strain to represent a type of organism based on agglutination tests two things must be considered: First, the antigenic properties of the strain, and, second, the agglutinogenic properties. The diagrammatic Charts I, II, III, and IV are of especial value in determining these properties. A description is given of the determination of the properties of strain 98. The properties of any other strain under consideration can be determined in the same way.

The antigenic properties of a given strain can be determined by noting the total number of lines radiating from its number on the antigen side of the charts, noting the destination of these lines, and comparing this number with the total number of serums which should have reacted with it as an antigen. This gives an indication of its antigenic relationships. For example, strain 98, Chart I, shows itself to be a very poor antigen for Type I, being agglutinated by only four of the seven Type I serums. In addition it was agglutinated by both of the Type III serums tried, which militates against it as a representative antigen of Type I. Chart II confirms this decision when it is observed that as an antigen it absorbs the homologous agglutinins only from its own serum.

The agglutinogenic properties of a given strain can be determined by counting the lines radiating from its number on the serum side of the charts, noting the destination of these lines, and then comparing the total number of antigens acted on by the given serum with the total number of antigens which it should have acted on in the same type. This gives the percentage of its agglutinogenic power. Thus strain 98, Chart I, is a good agglutinogenic strain, its serum bringing down 35 out of 45 of the Type I organisms. However, it is not a good specific representative strain, as it also agglutinates 22 out of 27 Type III organisms and one of three Type IV organisms. Moreover, in Chart II, when the absorption test is applied, Type III antigens remove its homologous agglutinins equally as well as do the Type I antigens.

Table VIII has been compiled from the charts with a view of establishing more definitely the superiority of the claims of some members of the selected strains to be good representatives of their types. The strain which one would select would, of course, depend upon whether a good antigenic or a good agglutinogenic strain was desired; that is, when a strain is not available that has both qualifications. The statements under "Remarks" are not deduced from the facts of the table, but from the charts. Judging from the facts as established either coccus 12 or 123 should be a good representative of Type I. Type II is well represented by coccus 55, but needs to be supplemented with either 56 or 136 to fulfill both antigenic and agglutino-

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genic qualifications. Type III is well represented by e
57 or 106, with the decision in favor of 57 if only one is
Strain 60 is a better representative of Type IV than 138, (
fact that 138 has broadened to include Type III.

By the use of similar methods and the tropin grou
forth in Miss Evans's accompanying paper the following
been selected as especially suitable for the manufacture
ingococcus serum for therapeutic use—Nos. 11, 55, 56,
123, 136, 138, 286, 289, 301.

Strains Nos. 55, 57, 60, and 123 have been selected
the titer of commercial antimeningococcus serum in a
and complement-fixing antibodies.

Further work needs to be done to determine the clas
freshly isolated strains, to determine satisfactory tests fo
ently inagglutinable strains, and to study the characteris
cultures from time to time.

The following conclusions are thought to be justified b
which have been obtained.

SUMMARY AND CONCLUSIONS.

1. Classification of strains according to their geogr
bution is not possible.

2. When the agglutination test with type serums pr
Gordon's types was applied to the Hygienic Laboratory
per cent of them were classified without further work.

3. If the meningococcus suspension agglutinates in
1–100 or higher, with only one of the type serums, p
homologous coccus agglutinates in over 1–400, it may
cent of the cases, be classified at once without resortin
sorption test.

4. If a meningococcus suspension agglutinates with t
type serums in equal titer, it may, in 100 per cent of t
classified by the absorption test.

5. If a suspension agglutinates with two or more typ
unequal titer, the highest titer probably indicates the
was true in 77 per cent of the cases tried.

6. In the monovalent serums tried, the complem
bodies have the same specificity as the agglutinins; the
fixation titer being as a rule somewhat higher than th
tion titer.

7. During the course of a year's time the apparent
certain strains of meningococci from one type to anoth
observ

8. ethod of selecting representative strains

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TABLE 1.—*History of hygienic laboratory meningococcus cultures.*

Isolation.			Details in history of the culture.	Original number.	Type indicated on original label.	Type indicated by simple agglutination test.	Type indicated by the absorption of agglutinins test.	Hygienic laboratory number.
Year.	Location.	By whom.						
	England(z)	Gordon	Received through Park	Type I, Gordon	Type I	I	I	135
	do	do	do	Type II, Gordon	II	II	II	136
		Rock. Inst	Said to correspond to Gordon's Type III.	R. I. No. 30	Irregular	III	III	57
	England(z)	Gordon	Received through Park	Type IV, Gordon	IV	IV	IV	138
	New York City	New York City Department of Health.	Dubois	No. 1		I, III	III	6
1916	Ellis Island	Lavinder		"T. G."		Not definite; I, III	I(?)	10
1916	do	do		"D. Z."		I	I	11
1916	do	do		"M. G."		I	I	12
1917	Middlesex Co., Va	Leake	"Robinson" serum treatment; recovered.			I	I	50
1917	Fort Meyer, Va	do	"Murray" serum treatment; recovered.			I	I	51
		Hitchins				I	I	52
		Rock. Inst	"Regular" strain	No. 1	Regular	II	II	55
		do	do	No. 10	do	II	II	56
		do	Irregular strain	No. 44	Irregular	II	II	58
		do	Para meningococcus	No. 62	Para	II	II	59
		do	do	No. 81	do	IV, II	IV?	60
1917	Baltimore, Md	Dr. Conrad, Johns Hopkins.	"Jackson"			I	I	61
1917	do	do	"Mueller"			I	I	63
1917	Garfield Hosp., Washington, D. C.	Lindsay	"Bunch"			III	III	64
1917	Chicago, Ill	Behrendet	"G. J. B."			III, I	III	93
1917	Garfield Hosp., Washington, D. C.		"J. T."			III, I	III	97
		Rock. Inst	Para meningococcus	No. 60	Para	III, I	Not indicated	98
1917	Cincinnati, Ohio	Dr. Wherry	Hermones			III, I	III	99
		Rock. Inst	"Regular"	No. 4	Regular	II	II	104
		do	"Irregular"	No. 37	Irregular	III, I	III	105
		do	do	No. 48	do	III	III	106
		Mulford	Said to correspond to H. L. No. 57.	No. 1		III	III	110
		do	Said to correspond to H. L. No. 98.	No. 137		I, III	I, III	111
1918	Charlotte, N. C		"Bradley"			II	II	112
1918	do		"Williams"			Not indicated	Not indicated	113
1918	Washington, D. C		"Hedding"			II	II	114

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TABLE I.—*History of hygienic laboratory meningococcus cultures*—Continued.

Isolation.			Details in history of the culture.	Original number.	Type indicated on original label.	Type indicated by simple agglutination test.	Type indicated by the absorption of agglutinins test.	Hygienic laboratory number.
Year.	Location.	By whom.						
	Fort Riley, Kans.	Mulford.	Gordon, Type No. 1	No. 250	I	I	I	115
1918	Chicago, Ill.	Mathers.	From Mulford's collect.	No. 177	IV	Not indicated	Not indicated	116
1918	Washington, D. C.	Leake.	"Franklin"			I	I	120
1918	Norfolk, Va.	Lake.	"Holland"			I, II	II	121
		Rock. Inst.	Through Navy Medical School.	No. 32		II	II	122
		do.						
1918	Columbia, S. C.	C. T. B.		No. 85				
1918	Washington, D. C.	Army Medical School.	"Counts"			I	I	123
1918	Camp Upton, N. J.	do.	"Hensey"	A200		I	I	124
1918	Camp Gordon, Ga.	do.	"Moore"	A202		I	I	125
1918	do.	do.	"Morton"	A208		I	I	126
1918	Camp Sherman, Ohio.	do.		A212		I	I	127
1918	Fort Sill, Okla.	do.		A213		Not definite, I?	Not definite, I?	128
1918	Washington, D. C.	Walter Reed Hospital.		A219		I?	Not indicated	129
		Board of Health New York City.		A223		II	II	130
		do.	Through Rock. Inst., said to be Gordon's.	Type I	I	III, I	III, I	131
		do.		Type II	II	III	III	132
1917–18		do.		Type IV	IV	II	II	133
		do.	From Rock. Inst., originally.	No. 30, irregular	Irregular	IV, III	IV, III	134
1917–18	New York City	do.		No. 205		II, III	III	137
1917–18	do.	do.		214		III, I	III	139
1917–18	do.	do.		215		I	I	140
1917–18	do.	do.		217		I	I	141
1917–18	do.	do.		218		II	II	142
1917–18	do.	do.		219		I, II	II	143
1917–18	do.	do.		220		I	I	144
1917–18	do.	do.		221		I	I	145
1917–18	do.	do.		223		I	I	146
1917–18	do.	do.		224		I	I	147
1917–18	do.	do.		225		I	I	148
1917–18	do.	do.		226		I	I?	149
1917–18	do.	do.		227		I	I	150
1917–18	do.	do.		228		III	III	151
1917–18	do.	do.		229		I	I	152
1917–18	do.	do.		230		I	I	153
1917–18	do.	do.		231		I	I	154
1917–18	do.	do.		232		I	I	155
				233		I, II	II	156
						II	II	157

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1917–18	.....do.....	.....do.....		235		I	I	158
1917–18	.....do.....	.....do.....		237		I	I	160
1917–18	.....do.....	.....do.....		238		I	I	161
1917–18	.....do.....	.....do.....		239		I, II	II	162
1917–18	.....do.....	.....do.....		241		I	I	163
1917–18	.....do.....	.....do.....		242		I	I	164
1917–18	.....do.....	.....do.....		244		I	I	165
1917–18	.....do.....	.....do.....		245		I	I	166
1917–18	.....do.....	.....do.....		246		II	II	167
1917–18	.....do.....	.....do.....		247		II	II	168
1918	St. Luke's Hospital	Rock. Inst				I	I	170
1918	New York City	.....do.....	Possibly same as 170, parameningococcus.		Para	I	I	172
1918	.....do.....	.....do.....	.....do.....		.....do.....	I	I	173
1918	.....do.....	St. Luke's Hospital	Basal meningitis			Not indicated	Not indicated	174
1918	.....do.....	From New York City Board of Health, through Mulford.	New York City No. 495, No. 20, Dovito.	Mulford No. 20	III	III	III	203
1912	.....do.....	Mulford	New York City No. 21, "Fleischer."	Mulford No. 21		II	II	204
1916	.....do.....	.....do.....	New York City No. 23, "John."	Mulford No. 23	I, III	III	III	205
1913	.....do.....	.....do.....	New York City No. 24, "Spahl."	Mulford No. 24	II	III	III	206
1916	.....do.....	.....do.....	New York City No. 1110, "Noce."	Mulford No. 31	I	III	III	208
1916	.....do.....	.....do.....	New York City No. 937, "Donnelly."	Mulford No. 40	I	II, III, IV	III	209
1918	.....do.....	.....do.....	New York City No. 942, "Orourke."	Mulford No. 41	II	II, III, IV	III	210
1914	.....do.....	.....do.....	"Christie" New York City No. 943.	No. 42	I	III	III	211
1918	Camp Jackson, S. C	.....do.....	"Tully" No. 14	No. 239	II	II	II	212
1918	Chicago, Ill	Naval Hospital	"Henkle" Mulford	No. 273	II	II	II	213
1918	.....do.....	Mulford	Naval Station, "Floyd"	No. 280	II	Not definite. II	Not definite. II	216
1918	Camp Beauregard, La	.....do.....	"Nobles"	No. 324	II	II	II	218
1918	Naval Station, Chicago, Ill.	.....do.....	"McCarty"	No. 336	II	I	I?	220
1918	Atlanta, Ga	.....do.....		No. 343		Not definite. I?	Not definite. I?	222
1918	Camp Greene, N. C	.....do.....		No. 297	II	II	II	223
1918	Philadelphia, Pa	.....do.....	Children's Hospital	No. 357	II	I, II	II	225
1918	Camp Gordon, Ga	.....do.....	Camp Gordon, No. 4247	No. 359	I	Not definite. I	Not definite. I	227
1918	Philadelphia, Pa	.....do.....	Samariton Hospital	No. 361	III	III	III	228
1918	Camp Doniphan	.....do.....		No. 364	II	II	II	229

Our thanks are gratefully extended to those furnishing us the cultures indicated in this table.

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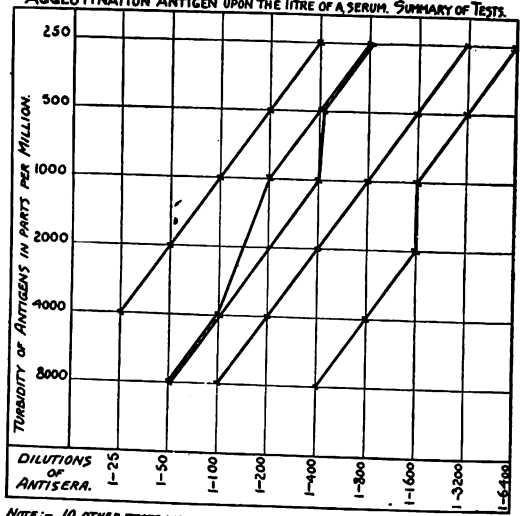
TABLE II:- EFFECT OF VARYING THE TURBIDITY OF AN AGGLUTINATION ANTIGEN UPON THE TITRE OF A SERUM. SUMMARY OF TESTS.



NOTE:- 10 OTHER TESTS WERE MADE. ALL SHOWED SIMILAR RESULTANTS. DATA IS OMITTED TO AVOID CONFUSION.

TABLE III.—*Results of agglutination and absorption tests using antiserums prepared from Gordon's type strains.*

Type indicated.	Suspensions of meningococci Hygiene Laboratory No.	Highest titers of serums yielding complete agglutinations using—				Absorption tests with[1]—			
		Type I, 135.	Type II, 136.	Type III, 57.	Type IV, 138.	Type I, serum 135.	Type II, serum 136.	Type III, serum 57.	Type IV, serum 138.
I	135	400	0	0	0	+	Not indicated.	Not indicated.	Not indicated.
II	136	400	400	0	0	0	+	....do	Do.
III	57	0	0	400	0	Not indicated.	Not indicated.	+	Do.
IV	138	0	0	0	200	....do	....do	Not indicated.	+
III	6	400	0	400	0	0	....do	+	Not indicated.
	10	0	0	0	0	Not indicated.	....do	Not indicated.	Do.
I	11	800	0	50	0	+	....do	....do	Do.
I	12	800	0	0	0	+	....do	....do	Do.
I	50	400	0	0	0	+	....do	....do	Do.
I	51	400	0	0	0	+	....do	....do	Do.
I	52	400	0	0	0	+	....do	....do	Do.
II	55	50	100	0	0	Not indicated.	+	....do	Do.
II	56	0	100	0	0	....do	+	....do	Do.
III	57	0	0	400	0	....do	Not indicated.	+	Do.
II	58	0	100	0	0	....do	+	Not indicated.	Do.
II	59	0	100	0	0	....do	+	....do	Do.
IV	60	50	0	0	400	....do	Not indicated.	....do	+
I	61	800	(2)	0	0	(2)	Not indicated.	....do	Not indicated.
III	63	400	0	0	0	+	....do	+	Do.
III	64	50	0	400	0	Not indicated.	....do	+	Do.
III	93	100	0	800	0	0	....do	+	Do.
III	97	200	0	800	0	0	....do	+	Do.
I-III	98	100	0	800	0	0	....do	0	Do.
III	99	100	0	800	0	0	....do	+	Do.

[1] + Indicates absorption; 0 indicates no absorption.

[2] Culture lost.

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TABLE III.—*Results of agglutination and absorption tests using antiserums prepared from Gordon's type strains*—Continued.

Type indicated.	Suspensions of meningococci Hygiene Laboratory No.	Highest titers of serums yielding complete agglutinations using—				Absorption tests with—			
		Type I, 135.	Type II, 136.	Type III, 57.	Type IV, 138.	Type I, serum 135.	Type II, serum 136.	Type III, serum 57.	Type IV, serum 138.
II	104	0	200	0	0	Not indicated.	+	Not indicated.	Not indicated.
III	105	100	50	800	0	0	Not indicated.	+	Do.
III	106	0	0	400	0	Not indicated.	do	+	Do.
III	110	0	0	400	0	do	do	+	Do.
I-III	111	800	0	400	0	+	do	+	Do.
	112	0	100	(2)	0	Not indicated.	(2)	(2)	Do.
	113	50	0	0	0	do		Not indicated.	Do.
II	114	0	200	0	50	do	+	do	0
I	115	400	0	0	0	+	Not indicated.	do	Not indicated.
	116	0	0	0	0	Not indicated.	do	do	Do.
I	120	200	0	0	0	+	do	do	Do.
II	121	200	100	0	0	0	+	do	Do.
II	122	0	200	0	0	Not indicated.	+	do	Do.
I	123	400	0	0	0	+	Not indicated.	do	Do.
I	124	800	0	0	0	+	do	do	Do.
I	125	400	0	0	0	+	do	do	Do.
I	126	400	0	0	0	+	do	do	Do.
I	127	800	0	0	0	+	do	do	Do.
	128	0	0	0	0	Not indicated.	do	do	Do.
	129	0	0	0	0	do	do	do	Do.
II	130	50	200	0	50	do	+	do	−
	131	0	0	100	0	do	Not indicated.	(2)	Not indicated.
III	132	0	0	400	0	do	do	+	Do.
II	133	0	200	0	50	do	+	Not indicated.	Do.
III-IV	134	0	0	200	400	do	Not indicated.	+	+
I	135	(3)	0	(4)	(3)	(3)	(4)	(3)	(3)
II	136	(4)	400	(4)	0	(4)	(4)	(4)	(4)
III	137	0	100	100	0	Not indicated.	0	+	Not indicated.
IV	138	0	0	0	200	do	Not indicated.	Not indicated.	+
III	139	100	0	800	0	0	do	+	Not indicated.
I	140	400	0	0	0	+	do	Not indicated.	Do.
	141	400	0	(2)	0	(3)	do	(2)	Do.
II	142	0	200	0	0	Not indicated.	+	Not indicated.	Do.
II	143	200	200	0	50	0	+	do	−
I	144	800	0	0	0	+	Not indicated.	do	Not indicated.
I	145	800	0	0	0	+	do	do	Do.
I	146	800	0	0	0	+	do	do	Do.
I	147	800	0	0	0	+	do	do	Do.
I	148	800	0	0	0	+	do	do	Do.
	149	0	0	0	0	Not indicated.	do	do	Do.
I	150	400	0	0	0	+	do	do	Do.
III	151	0	0	200	0	Not indicated.	do	+	Do.
I	152	800	0	0	0	+	o	Not indicated.	Do.
I	153	800	0	0	0	+	do	do	Do.
I	154	800	0	0	0	+	do	do	Do.
I	155	400	0	0	0	+	do	do	Do.
II	156	100	100	0	0	0	+	do	−
II	157	0	200	0	0	Not indicated.	+	do	Not indicated.
I	158	800	0	0	0	+	Not indicated.	do	Do.
I	160	400	0	0	0	+	do	do	Do.
I	161	800	0	0	0	+	do	do	Do.
II	162	800	200	0	0	0	+	do	Do.
I	163	800	0	0	0	+	Not indicated.	do	Do.
I	164	200	0	0	0	+	do	do	Do.
I	165	800	0	0	0	+	do	do	Do.
I	166	800	0	0	0	+	do	do	Do.
II	167	0	100	0	0	Not indicated.	+	do	Do.
II	168	0	200	0	50	do	+	do	Do.
I	170	800	0	0	0	+	Not indicated.	do	Do.
I	172	800	0	0	0	+	do	do	Do.
I	173	800	0	0	0	+	do	do	Do.
	174	0	0	0	0	Not indicated.	do	do	Do.
III	203	0	0	200	0	do	do	+	

[2] See 135 above.

[3] See 136 above.

[4] Culture lost.

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TABLE III.—*Results of agglutination and absorption tests using antiserums prepared from Gordon's type strains*—Continued.

Type indicated.	Suspensions of meningococci Hygiene Laboratory No.	Highest titers of serums yielding complete agglutinations using—				Absorption tests with—			
		Type I, 135.	Type II, 136.	Type III, 57.	Type IV, 138.	Type I, serum 135.	Type II, serum 136.	Type III, serum 57.	Type IV, serum 138.
II	204	0	100	0	0	Not indicated.	+	Not indicated.	Not indicated.
III	205	0	0	800	0	do	Not indicated.	+	Do.
III	206	0	0	200	0	do	do	+	Do.
III	208	0	0	400	0	do	do	+	Do.
III	209	0	100	200	100	do	0	+	—
III	210	0	100	200	100	do	±	+	—
III	211	0	0	800	0	do	Not indicated.	+	Not indicated.
II	212	0	200	0	0	do	+	Not indicated.	Do.
II	213	0	100	0	0	do	+	do	Do.
	216	0	0	0	0	do	Not indicated.	do	Do.
II	218	0	400	0	0	do	+	do	Do.
	220	100	0	(2)	0	(2)	Not indicated.	(2)	Do.
	222	0	0	0	0	(2)	do	Not indicated.	Do.
II	223	0	100	0	0	(2)	+	do	Do.
II	225	100	100	0	0	(2)	+	do	Do.
	227	0	0	0	0	Not indicated.	Not indicated.	do	Do.
III	228	0	0	400	0	do	do	+	Do.
II	229	0	200	0	0	do	+	Not indicated.	Do.

[1] + Indicates absorptions; 0 indicates no absorption.

[2] Culture lost.

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TABLE IV.—*Typing of certain strains of meningococci according to the agglutination and absorption of agglutinins tests, 1918 work.*

Antigens, Hygienic Laboratory No. of strains from which antigens were made.	Antiserums, Hygienic Laboratory No. of strains from which antiserums were made.													
	10	11	12	50	51	98	135	55	56	136	6	57	60	138
10	+	−	−	−	−	+	−	−	−	−	−	−	−	−
11	P	+	+	+	+	−	+	−	−	−	−	−	−	−
12	P	+	+	+	+	+	+	−	−	−	−	−	−	−
50	P	+	+	+	+	+	+	−	−	−	P	−	−	−
51	P	+	+	+	+	+?	+	−	−	−	P	−	−	−
82	P	+	+	+	+	+	+	−	−	−	−	−	−	−
61	−	−	+	+	+	−	−	..	..	..	−	..	..	..
63	P	+	+	+	+	+	−	−	−	−	P	−	−	−
98	P	−	P	P	P	+	P	−	..	−	P	P	−	−
115	−	−	−	+	−	+	+	−	−	−	−	−	−	−
120	P	+	+	+	−	+	+	−	−	−	−	−	−	−
123	−	+	+	+	+	−	+	−	−	−	−	−	−	−
124	P	+	+	+	−	+	+	−	−	−	P	−	−	−
125	P	+	+	+	−	..	+	−	−	−	P	−	−	−
126	P	+	+	+	+	+	+	−	−	−	−	−	−	−
127	P	+	+	+	+	+	+	−	−	−	−	−	−	−
128	P	−	−	−	−	+	−	−	−	−	−	−	−	−
129	+	−	−	−	−	+	−	−	−	−	P	−	−	−
135	P	+	+	−	+	−	−	−	−	−	−	−	−	−
140	P	+	+	+	+	+?	+	−	−	−	−	−	−	−
141	P	+	+	+	+	+?	+?	..	..	−	−	..	..	..
144	P	+	+	+	+	+?	+	−	−	−	P	..	−	−
145	P	+	+	+	+	+?	+	−	−	−	P	−	−	−
146	P	+	+	+	+	+?	+	−	−	−	P	−	−	−
147	P	+	+	+	+	+?	+	−	−	−	−	−	−	−
148	P	+	+	+	+	+?	+	−	..	−	P	..	−	..
149	P	−	+	−	+	+?	−	−	−	−	−	−	−	−
150	−	+	+	+	+	+?	+	−	−	−	−	−	−	−
152	P	+	+	+	+	+?	+	−	−	−	−	−	−	−
153	−	+	+	+	+	+?	+	−	−	−	P	−	−	−
154	P	+	+	+	+	+	+	−	−	−	P	−	−	−
155	P	+	+	+	+	+?	+	−	−	−	−	−	−	−
156	P	+	+	+	+	+	+	−	−	−	−	−	−	−
160	P	+	+	+	+	+?	+	−	−	−	−	−	−	−
161	P	+	+	+	+	+?	+	−	−	−	P	−	−	−
163	−	+	+	+	+	−	+	−	−	−	−	−	−	−
164	−	−	+	+	−	−	+	−	−	−	P	−	−	−
165	P	+	+	+	+	+?	+	−	−	−	P	−	−	−
166	P	+	+	+	+	..	+	..	..	−	P	..	..	..
170	P	+	+	+	+	+?	+	−	−	−	−	−	−	−
179	P	+	+	+	+	+?	+	−	−	−	−	−	−	−
220	P	+	+	+	+	..	+	..	..	−	P	..	..	..
222	−	−	−	−	−	..	+?	P	..	−	−	..	..	..
227	+	−	−	−	−	+	−	−	−	−	−	−	−	−
55	+	−	−	−	−	+	−	−	−	−	−	−	−	−
56	−	−	−	−	−	−	−	+	+	+	−	−	P	−
58	−	−	−	−	−	−	−	+	+	+	−	−	−	−
59	−	−	−	−	−	−	−	+	+	+	−	−	−	−
104	−	−	−	−	−	−	−	+	+	+	−	−	−	−
112	−	−	−	−	−	−	−	+	+	+	−	−	−	−
114	−	−	−	−	−	−	−	P+?	+	+?	−	..	..	..
121	−	−	−	−	−	−	−	+	+?	+	−	−	−	−
122	−	−	−	−	−	−	P	+	−	+	−	−	−	−
130	−	−	−	−	−	−	−	+	+?	+	−	−	−	−
133	−	−	−	−	−	−	−	P	+?	+	−	−	−	−
136	−	−	−	−	−	−	−	+	+?	+	−	−	−	−
142	−	−	−	−	−	−	P	+	+?	+	−	−	P+?	−
143	−	−	−	−	−	−	−	+	+?	+	−	−	−	−
156	−	P	P	−	P	−	P	+	+?	+	−	−	−	−
157	−	−	−	−	−	−	P	+	+?	+	−	−	−	−
162	−	−	−	−	−	−	−	+	−	+	−	−	−	−
167	P	−	−	−	−	−	P	+	−	+	−	−	−	−
168	−	−	−	−	−	−	−	+	−	+	−	−	−	−
204	−	−	−	−	−	−	−	+	−	+	−	−	−	−
212	−	−	−	−	−	−	−	+	−	+	−	−	−	−
213	−	−	−	−	−	−	−	+	+?	+	−	−	P	−
216	−	−	−	−	−	−	−	+	−	+	−	−	−	−
218	−	−	−	−	−	−	−	+	−	+	−	−	P	−
									+?					

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TABLE IV.—*Typing of certain strains of meningococci according to the agglutination and absorption of agglutinins tests, 1918 work*—Continued.

Antigens, Hygienic Laboratory No. of strains from which antigens were made.	Antiserums, Hygienic Laboratory No. of strains from which antiserums were made.													
	10	11	12	50	51	98	135	55	56	136	6	57	60	138
223	−	−	−	−	−	−	−	−	−	+	−	−	−	−
225	−	−	−	−	−	−	−	P	−	+	−	−	−	−
229	−	−	−	−	−	−	−	+	+?	+	−	−	−	−
6	P	−	P	P	P	+?	P	−	−	−	+	+	−	−
57	P	−	P	−	−	+	−	−	−	−	P	+	−	−
64	+	−	P	P	−	+	−	−	−	−	P	+	−	−
93	P	−	P	−	P	+	P	−	−	−	P	+	−	−
97	P	−	−	−	−	+?	P	−	−	−	+	+	−	−
99	P	−	−	−	−	+	P	−	−	−	+	+	−	−
105	P	−	−	−	−	+?	P	−	−	−	+	+	−	−
106	P	−	−	−	−	+	−	−	−	−	+	+	−	−
110	P	−	P	−	−	+	−	−	−	−	P	+	−	−
111	+	+	+	+	+	+	+	−	−	−	−	+?	−	−
131	P	−	+	+	−	+?	−	−	−	P	+	+	−	−
132	P	−	−	P	−	+	−	−	−	−	P	+	−	−
137	−	−	−	−	−	−	−	−	−	−	P	+	−	−
139	P	−	P	−	−	+	−	−	−	−	−	+	−	−
151	P	−	−	−	−	+	P	−	−	−	−	+	−	−
203	P	−	−	−	−	+	−	−	−	−	−	+	−	−
205	P	P	P	−	−	P	−	−	−	−	−	+	−	−
206	P	−	−	−	−	+	−	−	−	−	−	+	−	−
208	P	−	−	−	−	+?	−	−	−	P	−	+	−	P
209	−	−	−	−	−	+?	−	−	−	P	−	+	−	P
210	−	−	−	−	−	+?	−	−	−	−	P	+	−	−
211	P	−	−	−	−	+	−	−	−	−	P	+	−	−
228	P	−	−	−	−	+?	−	−	−	−	P	+	−	−
60	−	−	−	−	−	−	−	−	+?	−	−	−	+	+
134	−	−	−	−	−	−	−	−	−	−	P	+	−	+
138	−	−	−	−	−	−	−	−	−	−	−	−	−	−
113	−	−	−	−	−	−	−	−	+?	−	−	−	−	−
116	−	−	−	−	−	−	−	−	−	−	−	−	−	−
174	−	−	−	−	−	−	−	−	−	−	−	−	−	−

+ Indicates agglutination and absorption of agglutinins positive.
P Indicates agglutination positive absorption of agglutinins negative.
− Indicates agglutination negative absorption of agglutinins negative.
+? Indicates agglutination very good; absorption not tried.

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TABLE V.—*Classification of meningococci, 1919 work, using 3 serums made from each strain tested.*

Strains used as antigens.	Numbers of strains from which serums were made.																				
	11	11	11	12	12	12	50	50	50	123	123	123	55	55	55	56	56	56	64	64	136
11	+	+	+	+	+	+	−	P	P	+	+	+	−	−	−	−	−	−	−	−	−
12	+	+	+	+	+	+	−	P	−	+	+	+	−	−	−	−	−	−	−	−	−
50	−	−	−	−	−	−	+	+	+	−	−	−	−	−	−	−	−	−	−	−	−
123	+	+	+	+	+	+	−	P	−	+	+	+	−	−	−	−	−	−	−	−	−
55	−	−	−	−	−	−	−	−	−	−	−	−	+	+	+	−	P	−	−	−	−
56	−	−	−	−	−	−	−	−	−	−	−	−	+	+	+	+	+	+	P	+	+
64	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	+	P	P	+	+	−
136	−	−	−	−	−	−	−	−	−	−	−	−	+	+	+	+	+	+	P	+	+
57	−	P	−	−	−	−	P	+	P	−	−	−	−	−	−	−	−	−	−	−	−
106	−	−	−	−	−	−	P	+	P	−	−	−	−	−	−	−	−	−	−	−	−
110	−	−	−	−	−	−	P	P	P	−	−	−	−	−	−	−	−	−	−	−	−
138	−	−	−	−	−	−	−	−	P	−	−	−	−	−	−	−	−	−	−	−	P
60	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	P
135	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	P

Strains used as antigens.	Numbers of strains from which serums were made.																				
	136	136	57	57	57	106	106	106	110	110	110	138	138	138	60	60	60	135	135	135
11	−	−	P	P	P	+	−	P	−	P	−	−	−	P	−	−	−	P	−	−
12	−	−	−	−	P	−	−	−	−	−	−	−	−	P	−	−	−	P	P	−
50	−	−	+	P	+	+	−	+	−	P	−	P	−	P	−	−	−	−	−	−
123	−	−	−	−	P	P	−	P	−	−	−	−	−	−	−	−	−	−	−	−
55	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−
56	+	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−
64	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−
136	+	+	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−
57	−	−	+	+	+	+	+	+	+	+	+	P	P	P	−	−	−	−	−	−
106	−	−	+	+	+	+	+	+	+	+	+	P	P	P	−	−	−	−	−	−
110	−	−	+	+	+	+	+	+	+	+	+	P	P	P	−	−	−	−	−	−
138	−	P	+	P	P	−	P	P	−	P	−	+	+	+	P	P	P	+	P	+
60	−	P	−	−	−	−	−	−	−	−	−	P	P	P	+	+	+	+	+	+
135	−	P	−	−	−	−	−	−	−	−	−	P	P	P	+	+	+	+	+	+

+ Indicates agglutination and absorption of homologous agglutinins positive.
P Indicates agglutination positive, absorption of homologous agglutinins negative or not complete.
− Indicates no reaction whatever or reaction in too low a titer to be indicative.

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TABLE VI:—AGGLUTINATION, COMPLEMENT FIXATION AND TROPIN REACTIONS OF MONOVALENT ANTIMENINGOCOCCIC RABBIT SERUM.

SERA NUMBERED AS ANTIGENS SERA.	ANTIGENS. ANTIGENS NUMBERED ACCORDING TO THE H.L. NUMBERS OF THE STRAINS OF MENINGOCOCCI FROM WHICH THEY WERE MADE. THE TITRE OF EACH ANTIBODY IN THE SERUM IS RECORDED IN HUNDREDS.																							
	11			12			123			55			56			64			136					
	AGGL.	COMP. F.	TROPIN	AGGL.	COMP. F.	TROPIN	AGGL.	COMP. F.	TROPIN	AGGL.	COMP. F.	TROPIN	AGGL.	COMP. F.	TROPIN	AGGL.	COMP. F.	TROPIN	AGGL.	COMP. F.	TROPIN	AGGL.	COMP. F.	TROPIN
11 A	4	5/20		1			2	10/20		0	0/10		0	0/20		0			0					
11 B	8	10/20	/	8			8	20/20	3	0	0/10		0	0/20		0			0					
11 D	8	5/20		4			4	5/20		0	0/10		0	0/20		0			0					
12 B	8			8	5/10		4	10/20		0	0/10		0	0/10		0			0					
12 D	8			8	5/10		8	5/20		0	0/10		0	0/10		0			0					
12 E	4			4	20/40		4	20/20	0	0	0/20		0	5/40		0			0					
123 A	8			8			8	5/10	/	0	0/10		0			0			0			0	0/10	
123 B	8			8			8	10/20	/	0	0/20		0			0			0					
123 D	8			8			8	20/20		0	0/20		0	0/20		0			0					
55 C	0			0			0	0/40	0	8	10/20	/	8	20/20		0			4	20/20				
55 E	0			0	0/10		0	0/20		4.	2.5/10	/	4	5/10		0			4					
55 F	0			0			0	0/20		4	5/20	½	4	10/20		0			4					
56 A	0			0			0	0/10		0	0/10		4	10/10		2			4	10/10				
56 B	0			0			0	0/10		1	0/10	0	8	20/10	0	8			8	20/10				
56 D	0			0			0	0/40		0	0/20		8	20/20		0			8	40/20				
64 B	0			0			0	0/20		0	0/10		4	10/20		8	20/10	3	4					
64 D	0	—		0			0	0/20		0	0/10		2	2.5/20		4	5/10		2					
136 A	0			0			0	0/10		0	0/10	0	4	10/10		0			4	10/10	½			
136 B	0			0			0	0/10		0	0/10	0	4			0			4	10/10	0			
136 C	0			0			0	0/20	0	0	0/10	½	4			0			4	5/10	½			
50 B	0	—		0			½	20/20		0	0/20		0	0/20		0			0					
50 C	1	—		½	10/40		½	40/40		0	0/20		0	10/40		0			0					
50 D	2			0			½	5/20	/	0	0/20		0	0/20		0			0					
57 A	2			½			½	2.5/10		0	0/10		0			0			½	0/10				
57 B	2	—		0			0	2.5/10		0	0/10		0			0			0	0/10				
57 C	4			1			2	5/20		0	0/10		0			0			½	0/10				
106 A	4	—		½			1	5/20		0	0/20		0	0/20		0			0					
106 C	1			0			0	0/10	/	0	0/10		0	0/10		0			0	0/10				
106 G	4	—		½			1	20/20		0	2.5/20		½	5/20		0			½					
110 B	0	—		0	2.5/40		0	10/40		0	0/20		0	0/20		0			0					
110 D	1	2.5/20		0			0	5/20	3	0	0/10	0	0	0/20		0			0					
110 G	0	—		0			0	2.5/20		0	0/20		0	0/20		0			0					
60 G	0	—		0			0	0/20		0	0/20		0	0/20		0			0					
60 H	0			0			0	0/20	0	0	0/10	0	0	0/20		0	0/10		0					
60 I	0	—		0	0/10		0	0/20		0	2.5/10		0	0/10		0			0					
135 A	1			1			0	0/10		0	0/10	0	0	0/10		0			½	0/10				
135 D	0			1			0	2.5/10	0	0	2.5/10	0	0			0			0	0/10				
135 M	0	—		0			0	0/10		0			0			0			0					
138 A	0			0			0	0/10		0	0/10	0	0			0			0	0/10				
138 B	0			0			0	0/20		0	0/10	0	0			0			0	0/10				
138 C	1			1			½	0/10		0	0/10	½	0	0/10		0			½	0/10				
STANDARD	8			8			4			4			4			4			2					

NOTE:—THE HEAVY LINES EMPHASIZE GROUP RELATIONSHIPS.

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TABLE VI:- AGGLUTINATION, COMPLEMENT FIXATION AND TROPIN REACTIONS OF MONOVALENT ANTIMENINGOCOCCIC RABBIT SERUM.

ANTIGENS — ANTIGENS NUMBERED ACCORDING TO THE H L. NUMBERS OF THE STRAINS OF MENINGOCOCCI FROM WHICH THEY WERE MADE. THE TITRE OF EACH ANTIBODY IN THE SERUM IS RECORDED IN HUNDREDS.																								SERA NUMBERED AS ANTIGENS. SERA.
50			57			106			110			60			135			138						
Aggl.	Comp. F.	Tropin	Aggl.	Comp. F.	Tropin	Aggl.	Comp. F.	Tropin	Aggl.	Comp. F.	Tropin	Aggl.	Comp. F.	Tropin	Aggl.	Comp. F.	Tropin	Aggl.	Comp. F.	Tropin				
0			0	2.5/10		½			½	2.5/5		0	0/20		0	0/10		0						A 11
0			0	0/10		1			½	0/5		0	0/20		0	0/10		0						B 11
0			0	2.5/10		½			½	2.5/5		0	0/20		0	0/10		0						D 11
0			0	2.5/10	3	0			0			0	0/10		0	0/10		0	0/10					B 12
0			0	0/10	1	0			0			0	0/10		0	0/10		0	0/10					D 12
0	20/20		0	2.5/20		0			0	0/20		0	2.5/40		0			0						E 12
0			½	0/10	3	0	0/5		0			0	0/10		0	0/10		0	0/10					A 123
0			0	0/10	1	0			0			0	0/20		0			0						B 123
0			½	5/20		½	2.5/10		½			0	0/20		0	0/20		0	0/20					D 123
0			0	0/20		0			0			0	0/20		0	0/10		0	2.5/20					C 55
0			0	0/10		0			0			0	0/10		0	0/20		0	0/10					E 55
0	0/20		0	0/10		0			0	0/5		0	0/20		0	0/10		0						F 55
0			0	0/5		0			0			0	0/10		0	0/10		0	0/10					A 56
0			0	0/5		0			0			0	0/10		0	0/10		0	0/10					B 56
0			0	0/20		0			0			0	0/20		0	0/40		0	0/20					D 56
0			0	0/10		0			0			0	0/10		0	0/10		0	0/10					B 64
0			0	0/10		0			0			0	0/10		0	0/10		0	0/10					D 64
0			0	0/10		0	0/5		0			2			1	0/10		2	0/10					A 136
0			0	0/10		0	0/5		0			0	0/10		0	0/10		0	0/10					B 136
0			0	0/5		0	0/5		0			1	0/10		1	0/10		2	0/10					C 136
2	10/20		2	10/20		1			1	5/5		0	0/20		0	0/10		0						B 50
4	20/20		2	20/20		2			2	10/20		0	2.5/40		0			0						C 50
4	10/20	1	4	5/10	3	4			2	5/5		0	0/20		0	0/10		2						D 50
4			8	10/10	3	4	5/5		4			0	0/10		0	0/10		2	2.5/10					A 57
4			8	10/10		4	10/10		4			0	0/10		0	0/10		2	2.5/10					B 57
4			8	20/20	1	4	10/10		4			0	0/10		0	0/10		2	0/10					C 57
2			4	20/20		2	5/10		2			0	0/10		0	0/20		0	0/20					A 106
1			4	5/10	1	4	5/10	½	4			0			0	0/10	0	2	2.5/10					C 106
4			8	20/10		8	20/10		8			0	0/10		0	0/20		2						G 106
0	20/40		2	5/20		2			2	5/20		0	0/40		0			0						B 110
2			4	5/10	3	2			2	2.5/5		0	0/20		0	0/10		1	0					D 110
0	5/20		2	2.5/10		2			2	5/5		0	5/20		0	0/10		0						G 110
0			0	0/10		0	0/10		0			2	20/10		2	20/20		4						G 60
0			0	0/10	0	0			0			4	20/10	1	4	10/10		4	5/10	0				H 60
0			0	0/10		0			0			2	10/10		2	5/10		1	10/10					I 60
0			0	0/10		0	0/5		0			2			2	2.5/10	3	2	5/10					A 135
0			0	0/10		0	0/10		0			4	20/10		4	20/20	3	8	20/10	3				D 135
0			0			0			0			1	2.5/10		1	0/10		1						M 135
0			2	0/10		2	2.5/5		2			2	5/10	½	1	2.5/10		8	10/10	3				A 138
½			2	0/5		2	0/5		2			2	2.5/10		1	2.5/10		4	10/10	3				B 138
2			4	2.5/10		2	0/10		2			2			1	0/10		4	5/10	0				C 138
4			4			4			4			2			2			4						STANDARD

L.H. WILDER.

NOTE:- THE HEAVY LINES EMPHASIZE GROUP RELATIONSHIPS.

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TABLE VII.—*Classification of certain strains of meningococci by various investigators.*

Hygienic laboratory No. of strain.	Hygienic laboratory type.	(Amoss) Rockefeller Institute.		(Mulford) Gordon types.	(Andrews) Dopter classification.
		Culture No.	Classification.		
55	II	1	Normal or regular	II	Para.
56	II	10	do	IV	Do.
104	II	4	do	Not typed	Do.
57	III	30	Irregular	III	Meningococcus.
58	II	44	do	I	Do.
106	III	48	do	Not typed	Do.
59	II	62	Para meningococcus	II	Para.
60	IV	81	Para	IV	Do.
98	I or III	60	do	Not typed	Meningococcus.

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TABLE VIII.—*Comparison of the antigenic and the agglutinogenic properties of certain representative strains selected from the four types of meningococci.*

Hygienic Laboratory No. of the strain compared.	Hygienic Laboratory type.	1918 results.						1919 results.						Remarks indicating specifity affected by serum or antigen.
		Antigenic properties.			Agglutinogenic properties.			Antigenic properties.			Agglutinogenic properties.			
		Number serums acting on.	Possible number of serums to act.	Percentage.	Number antigens acted on by.	Possible number of antigens to act on.	Percentage.	Number serums acting on.	Possible number of serums to act.	Percentage.	Number antigens acted on by.	Possible number of antigens to act on.	Percentage.	
11	I	6	7	85	34	45	75	9	9	100	3	3	100	Not specific as antigen or as serum.
12	I	7	7	100	39	45	86	9	9	100	3	3	100	Serum broad, antigen good.
123	I	5	7	71	.....	.....	.....	9	9	100	3	3	100	Specific. Good broad antigen and serum.
55	II	2	2	100	21	27	78	3	11	27	3	4	75	Specific. Serum broad, antigen narrow.
56	II	3	3	100	18	27	66	10	11	90	2	4	50	Specific. Serum narrow, antigen broad.
136	II	2	2	100	26	27	96	10	11	90	2	4	50	Specific. Serum broad, antigen broad.
6	III	2	2	100	9	23	39	.....	.....	.....	.....	.....	.....	Serum narrow, antigen fair.
57	III	1	2	50	23	23	100	12	12	100	4	4	100	Specific. Antigen and serum broad.
106	III	2	2	100	.....	.....	.....	12	12	100	4	4	100	Antigen and serum broad.
110	III	2	2	100	.....	.....	.....	12	12	100	3	4	75	Serum narrow, antigen broad.
60	IV	2	2	100	1	3	33	9	9	100	3	3	100	Specific. Antigen and serum good.
138	IV	1	2	50	3	3	100	8	9	89	3	3	100	Antigen and serum broad. Includes part of III.

"Broad," means that a serum agglutinates all of its own type; that as an antigen it is agglutinated by all of its own type serums.
"Narrow," means that a serum does not agglutinate all of its own type; that as an antigen is not agglutinated by all serums of its own type.

TABLE IX.—*Typing and history of certain meningococcus cultures received after the study had been started.*

Isolation.			Details in history of culture.	Original No.	Type indicated on original label.	Type by simple agglutination.	Type by absorption test.	Hygienic Laboratory No.
Year.	Location.	By or from whom.						
1917	Philadelphia, Pa.	Mulford	Spinal fluid	108	I		II?	265
1918	.....	Dr. J. P. Leake	Serum treatment; recovered; "Faunce."	.....	.....	I	I	273
1918	Walter Reed, Washington, D. C.	Army Medical School	Spinal fluid; Harry Hostley	A295	Normal	II	II	274
1918	New York City	New York City Department of Health.	Department of Health case No. 5123.	230	I	I	I	280

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TABLE IX.—*Typing and history of certain meningococcus cultures received after the study had been started*—Continued.

Isolation.			Details in history of culture.	Original No.	Type indicated on original label.	Type by simple agglutination.	Type by absorption test.	Hygienic Laboratory No.
Year.	Location.	By or from whom.						
1918	New York City	New York City Department of Health.	Department of Health case No. 4990.	212	I	I	I	281
1918	do	do	Department of Health case No. 174.	220	I	I, II	I	282
1918	do	do	Department of Health case No. 167.	221	I	I	I	283
1919	do	do	Department of Health case No. 4930.	206		I	I	284
1918	do	do	Department of Health case No. 6067.			I, II	II	286
1919	do	do	Department of Health case No. 4968.	208	I	I	I	287
1919	do	do	Department of Health case No. 6103.			IV	IV?	289
1919	New York	New York State Department of Health.	Department of Health case No. 6107.			II–IV	II, IV in part	290
		do	Labeled Standard C	(W 30B)	Irregular, III	III	III	291
		do	Stock	79B	Para. type I	I	I	292
		do	Standard D	(W 60B)		I	I	293
		do	Stock	1B		II	II	294
		do	Standard B	(10 B)		III, IV	III	295
		Rock. Inst		No. 31		III	III	296
		do		No. 61		III, IV	III, 100 per cent; IV, 50 per cent.	298
1919	New York City	New York City Department of Health.	New York City case No. 6267				II?	300
1919	do	do				II	II	301
1919	Garfield Hospital	Mulford	New York City case No. 6273			III, IV	III	302
		New York State Department of Health.	Spinal fluid; Leonard Price	206		II	II	303
1919	Middleburg, Va	Dr. Spitler		38A	III, irregular	I, III, IV		304
1919	New York City	New York City Department of Health.	Spinal fluid; serum treatment; died.			I, II	II?	305
1919	do	do		6520		I, II	I	306
1919	do	do		6546		IV	IV	307
				6558		II	II	308

Our thanks are gratefully extended to those furnishing us the above cultures as indicated in this table.

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		6540 6558	IV II	305 307 308

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II. THE TROPIN REACTIONS OF ANTIMENINGOCOCCUS SERUM.[1]

By ALICE C. EVANS, Sanitary Bacteriologist, United States Public Health Service.

DEFINITION OF TERMS.

There has been a confusion of terms in the literature concerning the antibodies in immune serum which promote phagocytosis; therefore a definition of terms is necessary at the outset. Neufeld (1913), who studied the subject comprehensively, distinguished clearly between two types of phagocytosis promoting antibodies. He described *tropins* as specific antibodies which are not affected by the usual inactivating temperatures. (They withstand a temperature of 56° C. for 30 minutes or longer.) The *tropins* act without the aid of complement. The *opsonins*, on the other hand, are complex, containing thermolabile complement as well as a more stable body. They are therefore inactivated by a temperature of 56° C. for 30 minutes. They are also inactivated by standing at ordinary temperatures. The opsonic amboceptor is specific, but the complement is not specific. Both the opsonins and the tropins prepare bacteria for phagocytosis without killing them and without visibly changing them. In this paper Neufeld's distinction between the opsonins and the tropins will be recognized, though no opinion is expressed as to their nonidentity.

HISTORICAL REVIEW.

Houston and Rankin (1907) were pioneers in applying the so-called opsonic test to the study of the meningococci. They carried out the test in capillary pipettes, according to the method which Wright and Douglas (1903) had devised for the study of tuberculosis and staphylococcic invasions, and they concluded, in part, from their study that "the opsonic method is of great value in the diagnosis of suspected cases of cerebrospinal meningitis," and that "this method should prove of value in estimating the potency of any proposed therapeutic serum for this disease."

The following year Neufeld (1908) published his work on meningococci. He carried out the phagocytic test successfully in reagent tubes, and concluded that there is a specific phagocytosis promoting action of immune serum which can be demonstrated constantly, that

[1] Submitted for publication Feb. 7, 1920.

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it appears in high dilutions of serum, and that by tl
parative content of various samples of serum in phag
bodies can be established.

Jobling, in 1909, published the results of his stud
possible methods for the standardization of antimenir
This author concluded that "the part taken by spe
promoting recovery suggests their employment as a
therapeutic activity of the antiserum."

Kraus and Baecher, in 1909, also studied the
methods of standardization of antimeningococcus
concluded that specific phagocytosis promoting
demonstrable in immune serum. They were uncerta
these antibodies or the antitoxins predominated in th
of the serum.

THE USEFULNESS OF THE PHAGOCYTIC T

In spite of the fact that after the thorough studie
German, and American investigators quoted above
mended the determination of the phagocytosis prom
as a measure of therapeutic activity of antimenin
there has been in this country scant progress in the
The test also has received little attention in foreign
the last few years. The serious outbreaks of meningi
and American Army camps during the war compel
to direct their attention to the study of potency test
gococcus serum and other methods of testing were g
The reasons for rejecting the phagocytic test may be
follows:

The alleged difficulties have been, first, normal h
sesses a variable but usually high content of op
spontaneous phagocytosis is of common occurrer
method is difficult of control, even in the hands of expe
so that far from uniform results are obtainable if a set
samples including serums from normal horses are sul
ers in different laboratories.

The study here reported suggests that the three r
rejecting the phagocytic test are all based upon tl
phagocytic reactions of meningococci have been al
investigators in recent years, and therefore there ha
cient knowledge to interpret the results correctly.

During the 10 years which have elapsed since t
hensive study of the phagocytosis promoting bodie
goc[illegible]um, the meningococci have been classi
[illegible] divided them into two groups—the p
[illegible]ar" strains—as indicated by their a

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agglutinin absorption reactions. Ellis (1915) found such a differentiation between Dopter's two groups as to suggest their probable complete immunological independence. Gordon (1917) found four types to comprise practically all of the epidemic strains which he encountered, and Gordon's four types have received considerable attention in recent years. The results of the study recorded in this paper confirm Ellis's opinion in regard to the independence of the chief groups, in so far as their tropin reactions are concerned. It is obvious therefore why uniform results were not obtained. Most previous investigators of the phagocytic reactions of meningococci have considered all strains as belonging to a single group, whereas they actually belong to several distinct groups, and uniform results can be obtained only when the grouping is taken into consideration.

Likewise the first and second objections to the test are dispelled by a better understanding of the facts, as presented later in the discussions of opsonins in normal serum and of spontaneous phagocytosis.

There is reason for believing that those antibodies which prepare bacteria for ingestion by the leucocytes may play an important part in the defense of an individual infected with the meningococcus. Inasmuch as it is possible to produce conditions in vitro, under which the reactions leading to phagocytosis may take place, it would appear that these reactions might be an indication of the therapeutic value of antimeningococcus serum, for they fulfill the two conditions which may be regarded as desirable in a potency test, namely, they probably take a part in the therapeutic action of the serum, and they are measurable quantitatively.

In view of the fact that no completely satisfactory method had been worked out for the standardization of antimeningococcus serum, the study here reported was undertaken to determine whether the difficulties encountered in the carrying out of the test for the determination of the phagocytosis promoting antibodies might not be overcome.

DESCRIPTION OF METHODS.

The technique employed was that of Neufeld (1908), modified considerably in its adaptation to the problem at hand.

PREPARATION OF THE SERUM DILUTIONS.

The serum dilutions were made in Locke's[1] solution in values equivalent to one-half the final dilution desired. The final dilutions were commonly 1–50, 1–100, and 1–300. Hence the serum was diluted to 1–25, 1–50, and 1–150. Two-tenths of a cubic centimeter of the serum dilutions was transferred to reagent tubes (10 mm. by 75 mm.) in which the tests were to be made.

[1] Locke's solution consists of 9 grams of sodium chloride, 0.24 gram calcium chloride, 0.42 gram potassium chloride, 0.15 gram sodium bicarbonate, and 1 gram dextrose in a liter of water.

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PREPARATION OF THE BACTERIAL SUSPENSION.

Inasmuch as meningococci autolyze readily, and because the success of the test depends upon having the cocci in a good condition to take the stain at the end of the test, the preparation of the bacterial suspension requires special care. It is necessary to have very young and rapidly growing cultures.

Transfers of each strain to be tested were made on two serum glucose agar slopes at about 4 o'clock on the day before the test was to be carried out. One slope was placed in the incubator (37° C.) and the other was left at room temperature until midnight, when it was likewise placed in the incubator. Ordinarily the bacterial suspensions were made between 1 and 2 o'clock on the following afternoon. If the cultures which had been placed in the incubator at midnight had grown sufficiently they were used for the test. They were therefore about 13 hours old when used. Usually, but not always, there was sufficient growth on the 13-hour cultures. If they were not in the right condition, the 21-hour cultures were used.

The bacterial suspensions were made in equal parts of ordinary broth and Locke's solution. Two cubic centimeters of the mixture were added to each slope culture, the growth was rubbed off the slope with the end of the pipette and removed to a test tube, where it was drawn back and forth in the pipette until an even suspension was obtained. Then 0.2 c. c. of the suspension were removed to a homeopathic vial and a measured quantity was placed in a second test tube. The suspension in the vial was diluted with water until it matched in density a standard equivalent to 300 parts per million of silica, made up according to the turbidity standard adopted by the American Public Health Association (1917). The density of the suspensions was compared by reading through them letters of such size that they were just legible through the standard. The bacterial suspension in the vial was not used in the test, but the quantity of diluent added to it served for the calculation of the quantity of diluent necessary to make the final suspension equivalent to 300 parts per million of silica. Thus if 0.2 c. c. of the original suspension required 3.8 c. c. of water to make a suspension equivalent to 300 parts per million of silica. 1.8 c. c. of the mixture of Locke's solution and ordinary broth were added for every 0.2 c. c. of the original suspension to make up the suspension to be used in the test. Later the addition of an equal quantity of diluted serum made the final bacterial suspension equivalent to 300 parts per million of the silica standard. When all bacterial suspensions to be used on that day had been thus prepared, 0.2 c[illegible] suspension were transferred to each tube containing serum d[illegible] means of capacity capillary pipettes measuring exactly [illegible]antity. The tubes were shaken and then placed in a

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water bath at 37° C. to incubate for 45 minutes. During the incubation of bacteria and serum dilutions the leucocyte suspension was prepared.

OBTAINING THE LEUCOCYTES.

The leucocytes were obtained from the pleural cavity of rabbits. The day before the test was to be made, about 5 c. c. of sterile aleuronat suspension [1] were injected into each of the pleural cavities of 1 or 2 rabbits. When there were to be more than 90 tubes in the test, 2 rabbits were injected with the aleuronat.

On the following day the rabbit was killed with chloroform and the exudate in the pleural cavities was washed out with normal saline solution containing 1 per cent of sodium citrate, warmed to body temperature. A 50 c. c. centrifuge tube was filled with the leucocyte suspension washed from each pleural cavity. Usually small particles of aleuronat were washed out with the exudate. They sank to the bottom of the tube during the washing process and were disposed of by decanting the supernatant suspension into other centrifuge tubes. The leucocyte suspension was then centrifugalized for 4 minutes at such a speed that the majority of the leucocytes were thrown to the bottom of the tube, while the supernatant liquid remained cloudy (the cloudiness serving as an indication that the leucocytes had not been injured by too great compression). The supernatant liquid was poured away and about 10 c. c. of normal saline solution warmed to 37° C. were added to each tube. The leucocytes were uniformly distributed in the saline solution by gentle drawing back and forth in a pipette. About 40 c. c. more of warm normal saline solution were added to each tube, and the suspension was centrifugalized the second time in the same manner as before. The supernatant fluid was poured off and the leucocytes were carefully emulsified in a measured quantity of warm Locke's solution, allowing 0.2 c. c. for each test tube.

It was not found to be practicable to standardize accurately the density of the leucocyte suspension, because there was commonly a variable quantity of red blood corpuscles mixed with the leucocytes in the exudate. In small quantities the red cells did not interfere with the phagocytic reaction, but they did interfere with the standardization of the density of the leucocyte suspension by the transparency test. Inasmuch as it is important that the test shall proceed without delay, it appeared that the greater accuracy in regard to density of leucocytic suspension would not compensate for the loss of time consumed in a more complicated test. Therefore the only standard adopted for the leucocytic suspension was a uniform method

[1] The aleuronat suspension was made by adding 3 per cent starch and 5 per cent aleuronat to ordinary broth.

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of procuring the leucocytes. Those obtained from the exudate removed in the first 50 c. c. of washing from each pleural cavity of a good-sized rabbit were suspended in about 10 c. c. of Locke's solution. It was the common practice to include from 120 to 144 tubes in each day's test, thus requiring two rabbits to furnish the leucocytes. Frequently, the exudate from one of the pleural cavities was found to be very bloody. Such exudates were discarded, and the deficiency made up if necessary by further washing of the other cavity. Or sometimes the first fractions of the bloody washings were discarded and the later fractions would be sufficiently free of red blood corpuscles to be used in the test.

In preparing the leucocyte suspension great care had to be taken that the cells were kept in an active condition. They are liable to physical injury by compression if centrifugalized at high speed, by vigorous treatment in the washing, or by abnormal temperatures. They are liable to injury chemically by suspension in an unfavorable medium.

During the first few months of this investigation the leucocytic suspension was always examined in a hanging drop preparation under a microscope to make sure that it was free from bacterial contamination, and to note the condition of the leucocytes. If they were uninjured by the process of preparation, they showed numerous spiny pseudopodia. Such pseudopodia were always present when the process of preparation was carried out as described above, and an exudate contaminated with bacteria has been encountered only once during the investigation which has extended over more than a year: therefore the leucocytic suspension is no longer examined as a part of the routine test. This can not effect the accuracy of interpretation of results, for if the leucocytic suspension should be at fault, the controls included in the test would show the error.

After the 45 minutes' incubation of bacteria and serum dilutions, 0.2 c. c. of leucocyte suspension were added to each of the tubes, which were shaken to obtain a uniform suspension, and returned to the 37° C. water bath for another incubation period of 45 minutes. Twice during the second incubation each tube was rolled vigorously between the palms of the hands, in order to keep the leucocytes in suspension. (A better method for keeping the leucocytes in suspension is by the use of an electric shaking apparatus.) At the end of the 45 minutes, the tubes were removed from the water bath and smears were made.

Since the conditions were favorable for autolyzation of the meningococci, it was necessary to work quickly in making smears. The glass slides were labeled previously and laid on the table in the order in which the smears were to be made. If there were more than 35 or 40 smears to be made, a helper made a part of them. It was found to be

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important that the smears should be fixed and stained immediately after drying. They were fixed with methyl alcohol, dried without washing, and stained with a weak solution of carbol toluidin [1] blue for 12 seconds, and then with an exceedingly weak solution of safranin (4 drops of a 0.5 per cent aqueous or alcoholic solution of safranin in 50 c. c. of water) for 10 minutes or longer.

The proper staining of the smears is a delicate process, for it is necessary to stain the leucocytes just enough for their outlines to be seen, yet they must be transparent in order that the ingested cocci may be distinguished.

ORDER OF PROCEDURE.

For the benefit of those who may want to make use of the tropin test an outline of the order of procedure may be helpful.

First step: Inject aleuronat into the rabbits any time during the day preceding the test.

Second step: Inoculate slope cultures as late as practicable on the day preceding the test.

Third step: Prepare the protocol for recording the data.

Fourth step: Set up and label small reagent tubes for the test and large test tubes in which the serum dilutions are to be made. Clean and label the glass slides. (Six or eight smears can be made on one slide marked in squares.) Place conveniently 1 cc., 2 cc., 5 cc., and 10 cc. sterile pipettes and the special 0.2 cc. capillary pipettes.

Fifth step: Place in 37° C. water bath a flask of sodium citrate solution, a flask of normal saline solution, and a measured quantity of Locke's solution for the leucocyte suspension, calculating 0.2 cc. for each tube in the test. Prepare a mixture of equal parts of ordinary broth and Locke's solution for the bacterial suspension.

Sixth step: Measure into the large test tubes the required quantities of Locke's solution for the serum dilutions.

Seventh step: Prepare the serum dilutions and transfer them to the small reagent tubes in which the tests are to be carried out.

Eighth step (1 p. m.): Prepare the bacterial suspensions. The time required for this step will, of course, depend on the number of strains of meningococci to be used in that day's test. It can be assumed that it will require about 30 minutes.

Ninth step: Request an assistant to chloroform the rabbits and get them ready for removal of the leucocytic exudate, with the proper instruments at hand.

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[1] Bordet-Gengou's toluidin blue is made by dissolving 5 grams of toluidin blue in 100 c. c. alcohol, 500 c. c. water, and 500 c. c. of 5 per cent phenol, and filtering after 1 or 2 hours. One part of the stain was diluted with 2 parts of water for staining the smears.

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Tenth step (1.30 p. m.): Transfer 0.2 cc. of bacterial suspension to each reagent tube containing serum dilution.

Eleventh step (1.40 p. m.): Place the racks containing the reagent tubes in a 37° C. water bath.

Twelfth step: Prepare the leucocytic suspension. This will occupy most of the 45 minutes required for the incubation of serum dilutions and bacteria.

Thirteenth step (2.25 p. m.): Remove the racks containing the reagent tubes from the water bath, transfer 0.2 cc. of leucocyte suspension to each tube, and replace in the water bath.

Fourteenth step (3.10 p. m.): Remove the racks from the water bath and make the smears. All smears should be made, if possible, within 45 minutes after removal of the tubes from the water bath.

Fifteenth step: Fix the smears with methyl alcohol.

Sixteenth step: As soon as the alcohol has dried stain all smears with the carbol toluidin blue.

Seventeenth step: Stain with safranin.

When the above order of procedure is followed, 150 tubes can, with the aid of an assistant, easily be managed in one day's test

INTERPRETATION OF RESULTS.

Although the numerous macrophages showed active phagocytosis, they were not considered in this study, results being based on polymorphonuclear leucocytes. It was found impractical to attempt to count the number of cocci ingested by the leucocytes, for when the reaction was vigorous many of the cells were filled with the cocci, which were so crowded together that an estimation of the number present was impossible. Twenty-five polymorphonuclear leucocytes in each smear were examined, and the presence or absence of bacteria was recorded in terms of the percentage of polymorphonuclear leucocytes containing bacteria. It was observed that those leucocytes which were agglutinated generally contained more bacteria than the isolated leucocytes. Therefore, if there had been a clumping of leucocytes, one-half of the number counted were chosen from one or more groups and the other half were chosen from the isolated leucocytes. Record was kept of the percentage of leucocytes containing more than 10 cocci, because it was only rarely that a leucocyte containing more than that number was found in the control tubes. It appeared, therefore, that the record of such leucocytes would add some significance to the data. They were tabulated in terms of percentage of leucocytes "filled" with bacteria.

For every strain used in the test there was always included a control in Locke's solution and another in a 1–50 dilution of normal serum. It was a common occurrence to find that the controls in the Locke's solution and the normal serum gave a percentage of leucocytes

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ontaining bacteria varying from 4 to 20. Therefore, no result less han 32 was considered positive unless some of the leucocytes were 'filled" with bacteria. If, however, the controls gave a comparaively high phagocytic index, the phagocytic index of the tested erum was not considered positive unless it was at least twice as great s that of the controls.

Occasionally all the data obtained in a day's test had to be rejected ecause the controls in Locke's solution and in normal serum would how a marked phagocytic inclusion. The cause for this phenomenon s not clear, but it is possibly due to abnormal phagocytic powers of he leucocytes of some rabbits. Such an explanation is supported y Zinsser's statement that differences in phagocytic powers may eside in the leucocytes. A general phagocytosis in the Locke's olution and normal serum controls occurred so infrequently, however, hat the difficulties with spontaneous phagocytosis offer no serious bjection to the practical use of the phagocytic test.

Also it would occasionally happen that no positive results would e obtained with serum known to contain specific tropins. The cause or such results is explainable, for if the leucocytes were accidentally njured, or if conditions were unfavorable to their activity, they could ot ingest the bacteria. In order that there might be no false nterpretation of such results, it was necessary to include in every lay's test a positive control of an immune serum of known titer with ntigens of strains used in the test. If there was a failure to obtain he expected results with the positive control, all the data for that lay had to be rejected. After some experience with the test such ccidents were rarely encountered.

Table I illustrates typical protocols and the interpretation of esults. Phagocytosis of meningococci in immune serum is shown n Plate I, figure 1.

METHOD OF PRODUCTION OF IMMUNE SERUM.

Rabbits were used for the production of monovalent immune erum. Several methods of inoculation were tried, with varying esults. Only one method which proved to be successful will be described. Live cultures were used. The inoculations were made nto the ear vein at intervals of 3 or 4 days until 6 or 7 inoculations had been made. For the first dose about 150 million organisms were given. The dose was gradually increased so that about 600 million organisms were introduced in the last inoculation. The number of organisms was determined by the turbidity, considering 500 parts per million of the silica standard equivalent to 1 billion organisms per cubic centimeter. The antigen for inoculation was always suspended in two cubic centimeters of normal saline solution. The blood was drawn 3 or 4 days after the last inoculation. The serums were

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preserved by the addition of 0.2 per cent tricresol and kept in an ice box at a temperature of about 3° C. The method used by Butterfield and Neill for the production of agglutinins was equally as successful for the production of tropins as the method described above.

THE PROBLEM OF THE CLASSIFICATION OF THE PHAGOCYTIC ANTIBODIES OF ANTIMENINGOCOCCUS SERUM AS SERUM OPSONINS OR TROPINS.

In a recent publication Kolmer, Toyama, and Matzunami (1918) reported that the phagocytic activity of antimeningococcus serum diminished considerably after heating, or after the addition of 0.2 per cent tricresol, followed by standing at room temperature for 4 days or longer. These investigators reported that the addition of fresh normal human or guinea-pig serum to various antimeningococcus serums as prepared and marketed for administration was found definitely and uniformly to increase the opsonic activity for various strains of meningococci.

According to these investigators, therefore, the labile opsonins are important antibodies in fresh antimeningococcus serum, and they can be restored by the addition of complement. The studies here reported do not confirm those conclusions. Guinea-pig complement has been added to commercial serums in many tests. In some of the tests it was added in a constant ratio of 1–300 in each of the serum dilutions, and in other tests following Kolmer's technic, 1 part of the complement was added to 9 parts of immune serum before the dilutions were made. The results did not show phagocytic action in higher titer of immune serum with complement added than in the controls without complement. Repeated tests have failed to prove that a reaction is obtained in higher titer of commercial serum when complement has been added. The protocol for one day's test is given in Table II A. The serums were from the commercial laboratories, and the regular routine test to which they were subjected served as the control without complement.

The protocol for another experiment to show the action of complement is given in Table II B. The commercial serum used in this test was a comparatively poor one, giving only a slight positive reaction in the 1–100 and 1–150 dilutions, and a negative reaction in the 1–200 dilution. The addition of complement did not enhance the phagocytic activity, although dilutions were increased by slight gradations in order to show any slight effect of the complement. These results are in agreement with those of Clough (1919), who recently reported that if antipneumococcus serum had become inactive or feeble as a result of overheating, long preservation, or the phagocytic activity for pneumococci could not be restored by the addition of complement.

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An attempt was made to demonstrate opsonins in immune serum y approaching the problem from another angle. Fresh antimeninoccocus rabbit serums were heated at 56° C. for 30 minutes, and the hagocytic antibodies in the heated and unheated serums were etermined in a number of preliminary tests, which indicated that ıe phagocytic activity of the serums was not diminished by heating. . test for which the protocol is given in Table III A was made with ıe serums from seven rabbits, all of which had received the same ntigens for immunization, inoculated on the same days. The blood 'as drawn on the fifth day after the seventh inoculation, and the eated and unheated serums were tested for phagocytosis promoting ntibodies about five hours later.

The test was repeated with the serum from another group of five abbits. The protocol is given in Table III B.

There is no evidence that the activity of the serum was to any ıoteworthy degree diminished by the destruction of complement. Contrary to the conclusions of the mentioned authors, the results btained when complement was added to commercial serum, and vhen the phagocytic activity of heated and unheated fresh immune erums was compared, indicate that the labile opsonins of antineningococcus serum play a minor part in promoting phagocytosis s compared with the stronger activity of the tropins. In the words f Zinsser, "If thermolabile opsonins as distinct antibodies in imnune serum are rendered active by the addition of complement, hey are in such low dilution, as compared with the thermostable ropins, that their effect is not measurable."

In the remainder of this paper the phagocytic bodies of antimenngococcus serum will be referred to as tropins.

THE EFFECT OF LOW DILUTIONS OF SERUM ON PHAGOCYTIC REACTIONS.

The phenomenon of inhibition of reaction in excessive concenıration of antibody is well known for agglutinin, bacteriolysin, and precipitin reactions. Such a phenomenon appears not to be generılly recognized for the tropin reactions, although Neufeld (1913) varned against the inhibitive effect of excess of phagocytic antiıodies. Neufeld also stated that there is a toxin in serum which nhibits the action of the leucocytes of a foreign species. It is important to know the effect of low dilutions of serum on phagocytic reaction because a common method for carrying out the phagocytic test with antimeningococcus serum is that devised by Wright and Douglas (1903), according to which equal volumes of bacterial suspension, serum, and leucocytic suspension are incubated together, thus making a final dilution of 1–3.

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During the early part of this study polyvalent horse serums prepared for therapeutic purposes were tested in dilutions of 1–30 and higher. But it happened so frequently that a negative reaction was obtained in the 1–30 dilution when a positive reaction was obtained in the next higher dilution of 1–100, or the reaction in the 1–30 dilution was questionable when the 1–100 dilution gave a strongly positive reaction, that the method was altered and in the subsequent work a 1–50 dilution was the lowest tested.

The effect of low dilutions of fresh monovalent rabbit serum and of commercial polyvalent horse serum is shown in Table IV. Although the rabbit serum contained a high titer of tropins, it showed no inhibition of tropic action in the lowest dilutions of serum. On the other hand the commercial serum showed complete inhibition of tropic activity in the 1–3 and 1–10 dilutions, and only a slight activity in the 1–6 dilution.

The rabbit serum was preserved with 0.25 per cent phenol. The amount of preservative in the commercial serum was not stated, but the United States Public Health Service regulations do not permit more than 0.35 per cent of tricresol. Weaver and Tunnicliff found that 0.4 per cent of tricresol inhibits phagocytosis. But it does not seem at all probable that the toxic effect of the preservative could have influenced the results in these tests because it was present in such slight amounts in the dilutions of serum. The results given in Table IV, and others confirming them, indicate that a high concentration of tropins does not inhibit leucocytic action, but that the leucotoxin of horse serum inhibits the action of rabbit leucocytes to such an extent that the method of Wright and Douglas is not applicable to the testing of commercial serum with rabbit leucocytes. No doubt the common usage of this method is largely responsible for the prevalent idea that the phagocytic test is unreliable. The method of Wright and Douglas with low dilutions of serum can be relied upon only when serum and leucocytes are from the same species.

DETAILS CONCERNING THE STRAINS USED IN THIS STUDY.

The data submitted in this paper were obtained by studying 63 strains, all of which agree with the accepted description of meningococci in their cultural characteristics and staining reactions. The strains were all isolated from spinal fluid from cases of meningitis. All were classified as to their agglutination reactions with reference to the Gordon types by Butterfield and Neill and reported in their accompanying paper. By referring to Tables I and IX of their paper the details of the history of the strains can be determined, together information concerning their agglutination reactions.

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The strains numbered below 230 are given in Butterfield and Neill's Table I, and those numbered above 230 are given in their Table IX. The method of maintaining the strains is also given in their paper.

SUSCEPTIBILITY OF MENINGOCOCCI TO PHAGOCYTOSIS.

Jobling found that some strains of meningococci were too readily taken up by the leucocytes and some strains were not readily enough subject to phagocytic inclusion for use in this test. Neufeld (1908) also found his strains susceptible to the influence of serum in different degrees. As has been mentioned before, many of the difficulties of these earlier investigators were apparently due to the fact that the serological differentiation of the meningococci was not generally recognized.

It was the general opinion, expressed in the earlier literature to which Crowe (1915) has more recently acceded, that there is no phagocytosis of freshly isolated strains of meningococci with normal serum, but that after subculture phagocytosis may occur. Nevertheless, under the conditions of the test as applied in this study, the length of time the strain had been under artificial cultivation had nothing to do with spontaneous phagocytosis. Some of the strains in our collection had been isolated 3½ years at the time the tests were made, yet they showed no phagocytosis in Locke's solution nor in preserved normal rabbit and normal horse serum. On the other hand, 5 days after its isolation, strain 303, the youngest strain tested, was readily ingested by the leucocytes after treatment with commercial serum. Of the 63 strains included in this study only 4 have shown a tendency to spontaneous phagocytic inclusion.

With the exception of certain strains after long cultivation, to be discussed later, all 63 strains were rendered susceptible to phagocytosis by the action of specific serum. However, the strains were susceptible to phagocytosis in varying degrees, so that a given serum showing a high titer of tropins when tested with certain strains would show a lower titer when tested with other strains of the same group. Strains characterized by ready phagocytic inclusion, after treatment with immune serum, were not peculiar to any one group, but in every group there was a variation among the strains in that respect. Inasmuch as all strains were susceptible in some degree, the essential factor in obtaining a positive reaction with any strain was that the serum should contain tropins specific for that strain. In the case of the four strains subject to spontaneous phagocytosis the action of the immune serum was evidenced by a more pronounced phagocytic activity.

There has been observed a slight phagocytic reaction in low dilutions of fresh normal horse serum. This is probably due to the labile opsonins. Such a reaction is shown in Table IV. The percentage

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of phagocyting leucocytes is low, compared with that of immune serums, and there are no leucocytes filled with bacteria, so that the microscopic picture is quite different from that of a tropin reaction. However, preserved horse serum is the logical control when commercial serums are tested, hence the opsonins are not a disturbing factor. There has never been observed an opsonic activity of fresh normal rabbit serums in dilutions of 1–50 or higher.

THE TROPINOGENIC POWER OF MENINGOCOCCI.

Rabbits have been inoculated with 30 different strains representing the various groups of meningococci for the production of monovalent immune serum. In some cases several rabbits had to be inoculated before a production of tropins could be demonstrated, due, presumably, to the peculiarities of different rabbits. But the ability to produce tropins has been demonstrated for all tested strains. However, there appears to be variation in the tropinogenic power of the strains, some stimulating tropin production more rapidly and in higher final titers than other strains. Such variation bore no relationship to the serological grouping of the meningococci, but good strains and poor strains for tropin production were found in all groups. Elser and Huntoon (1909) found that although the most agglutinable strains produced the most powerful serums, there was no definite relationship between the agglutinability and the agglutinogenic power of meningococci, for some poorly agglutinable strains possessed good agglutinogenic properties. A similar statement may be made in regard to the tropin reactions. Generally those strains which were sensitive in their response to tropins were also good strains for the production of tropins. But some strains which were good for the production of tropins did not readily respond to the reaction of tropins. It will be shown later that after long cultivation the tropinogenic power of a strain may be lost.

SPECIFICITY OF TROPIN REACTIONS.

In Table V are shown the cross tropin reactions between several rabbit serums produced by strains representing each of Gordon's types and antigens representing those types. (In Table V and those following the serum is designated by the number of the strain used for producing it.) Two strains of Type I were used for antigens in these tests, because strain 135, which was first chosen to represent Type I, did not react with the serums produced by other strains of Type I, as shown in the table. But when strain 123 was used as an antigen, it was found to react with all serums of Type I, with the exception of 135, and also it reacted with all the serums of Type III. It did not react with the serums of Types II and IV.

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Antigen 57, representing Type III, reacted with all serums of Type I, with the exception of serum 135, and with all serums of Type III. It did not react with the serums of Types II and IV. Thus it appeared identical with strain 123 in respect to tropins.

Antigen 55, representing Type II, gave no reaction with the serums of Types I and III, but it reacted with all serums of Type II, and with one of the two serums of Type IV.

Antigen 138, representing Type IV, gave a positive reaction with serum 135 but with none of the other serums of Type I, and it reacted with none of the serums of Type III. It reacted with 4 of the 6 serums of Type II and with both serums of Type IV.

The tropin reactions therefore indicate that strain 135 does not belong to the same group as the other Type I strains, and that all strains of Type I represented in the tested serums, with the exception of strain 135, form a group, and that all strains of Type III represented in the tested serums fall in the same group as the majority of Type I strains. The simple tropin reactions also indicate that the strains of Type II form a group which is unrelated to Types I and III but is related to Type IV, and that the strains of Type IV are related to Type II and the group represented by strain 135.

TROPIN ABSORPTION TESTS.

Absorption tests were carried out to define more clearly the groups indicated by the simple tropin tests. Fresh antigens for the absorption tests were obtained by growing the cultures over night on glucose agar. The growth was removed by washing the agar with a small quantity of normal saline solution. The suspension was heated at 65° C. for 30 minutes and then diluted to a standard of turbidity. (The turbidity of each antigen is given in the tables.) Four and eight-tenths cubic centimeters of antigen were placed in a centrifuge tube and 0.2 c. c. of immune serum was added and well mixed in the suspension. The dilution of the serum was therefore 1–25. The serum-antigen mixture was incubated in a 37° C. water bath over night. The following day the antigen was precipitated by centrifugalization and the supernatant diluted serum was tested against suitable strains of meningococci.

Table VI shows the absorption of tropins from serum 135 (Type I). They were absorbed by the homologous antigen, but they were not absorbed by the antigens representing Types II, III, and IV, neither were they absorbed by antigen 123, representing the larger group of Type I.

Table VII shows again that strain 135 is not related to the strains of Type I that are represented by strain 123, for none of the tropins, specific for strain 123, were absorbed from serum 123 by strain 135.

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The tropins were completely removed from serum 123 by the homologous antigen by antigen 281 (Type I) and by antigen 203 (Type III), but they were not at all absorbed by the strains representing Types II and IV.

The serum used for the absorption test shown in Table VIII was prepared for experimental purposes at the laboratory of the New York City Department of Health by injecting a horse with a single strain of meningococcus. Acknowledgments are gratefully extended to Dr. Charles Krumwiede, Jr., for furnishing this serum. Strain 136 was used for the inoculations. This serum contained a much higher titer of tropins than the rabbit serums used in the preceding absorption tests. The data confirm the results obtained with the rabbit serums, namely, that in so far as tropins are concerned, there is no relationship between Type II strains on the one hand and strains of Types I and III on the other hand, for antigens of the latter types removed none of the Type II tropins. This test with the high-titer serum shows very nicely the relationship between Types II and IV, for although the tropins were completely removed from the Type II serum by the Type II antigen they were only partially removed by the Type IV antigen.

The data presented in Table IX, showing absorption from Type III serum, confirm the results indicated in Tables V and VII, namely, that the strains of Type III, and those of Type I which are represented by strains 123 and 153, are identical in their tropin absorptive capacities, and therefore form a single group in respect to tropin reactions, and that this group is distinct from Types II and IV.

Inasmuch as strain 138 is one which is subject to spontaneous phagocytosis, the results obtained by the test presented in Table X, showing absorption from Type IV serum, are not quite so definite as those tests presented in the preceding tables. However, if the figures shown in the negative control tests are borne in mind in the interpretation of the other figures of the table, it will be seen that only two of the tested antigens failed to remove tropins from the Type IV serum. Antigen 123 (Type I) and antigen 57 (Type III) absorbed no tropins. Antigen 135 (Type I) and antigen 55 (Type II) absorbed a part of them. They were completely removed by the homologous antigen and by another antigen (298) of Type IV. They were only partially removed, however, by antigen 60 of Type IV.

CLASSIFICATION OF MENINGOCOCCI ACCORDING TO THEIR TROPIN REACTIONS.

If the data obtained by the simple tropin tests (Table V) and those obtained by the tropin absorption tests (Tables VI–X) are considered, it will be seen that strains 135, 123, and 55, represent distinct groups; 57 (Type III) belongs to the same group as strain 123

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(Type I), and that strain 138 (Type IV) is somewhat related to strains 135 and 55.

Strains 135, 123, 55, and 138, were therefore taken as representatives of groups, and the available strains of meningococci, 63 in all, were tested for their tropin reactions for the purpose of classifying them on the basis of that grouping. For convenience of discussion it will be necessary to name the groups at the outset. The grouping, with the corresponding representative strains, is as follows:

Group	R	S	T	U	Z
Strain	123	55	135	286	138

In the following discussion, when the types of meningococci are mentioned, it will be with reference to Gordon's classification by agglutination reactions, and when the groups of meningococci are mentioned it will be with reference to their classification by tropin reactions.

Early in the classification study it became apparent that the strains of groups R, S, and T gave a positive phagocytic reaction only in serums of the homologous group. It appeared also that any strain of those groups was equal in its absorptive capacity to any other strain of the homologous group. Later, four strains were found to be slightly atypical in their absorptive capacities. They are discussed in connection with the data presented in Tables XIII and XIV. However, the finding of the four slightly atypical strains did not vitiate the general principle that the typical strains of groups R, S, and T are equal in their absorptive capacities. Hence, there were two methods for the classification of any strain of those three groups—the simple tropin reaction with monovalent serums, and the tropin absorption from a polyvalent serum.

In order to classify an unknown strain, usually the first procedure was to test it against monovalent serums of groups R, S, and T. If there was a distinctly positive reaction with any one of those serums, it was thereby referred to its group without further study. But after treatment with specific immune serum of a tropin titer of 1–100 or less, certain strains will show no phagocytosis, or so slight phagocytosis that the result may be doubtful. The strains of group Z give only slight reactions in monovalent serums of low titer of groups R, S, and T. Another characteristic of the group Z strains, shown in the simple tropin test, is their tendency to spontaneous phagocytosis. Whenever the classification of a strain by the simple tropin test was doubtful, it was subjected to the tropin absorption test with a polyvalent (commercial) horse serum. Such a test is illustrated in Table XI.

The polyvalent serum used in that test was one whose tropin properties were well known from previous tests. It was known that an antigen belonging to any of the groups R, S, or T and having a

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turbidity equal to 3,000 parts per million would absorb all the tropins of the homologous group. The serum was absorbed by antigens prepared from the strains to be tested, and the absorbed serum was tested against susceptible antigens of groups R, S, and T. Therefore, a negative reaction with only one of those antigens showed that the absorbing strain belonged to the group represented by that antigen. By its partial absorption of group S tropins, strain 298 was shown to belong to group Z.

The grouping of the 63 strains available for classification is given in Table XII, together with the types to which they belong, as determined by agglutinin reactions.

In this table, as well as in the text, the word "type" refers to classification by agglutinin relationships, while the word "group" refers to tropin classification. The relationship between the agglutinin types and the tropin groups is given in chart 1.

In this comparison of agglutinin and tropin reactions the strains were referred to their respective agglutinin types according to the criterion adopted by Butterfield and Neill, i. e., a strain must remove all, or practically all, its own agglutinins from the type serum, and after it has acted on the type serum, the titer of the type serum for its homologous type coccus must be reduced at least one-half, as compared with the unsaturated control agglutinin test. When an organism absorbed agglutinins from two or more type serums, the one showing the greater percentage of absorption on repeated tests was considered as the indicated type. Inasmuch as the majority of cases of cross agglutinin absorption were between Types I and III, and since the majority of strains of these two types are included in group R, it does not confuse the point under discussion to refer to Type I, for example, a strain which also absorbs Type III agglutinins. although other investigators might consider such a strain aberrant.

Thirty-nine strains, or 61.9 per cent, belonged to group R. They include 23 strains of Type I, 12 strains of Type III, two of Type II, one of Type IV, and one strain whose agglutinin reactions showed it to be related to Types III and IV. Group R, therefore, is made up chiefly of strains of Gordon's Types I and III (92.7 per cent), together with a small percentage of strains belonging to other types. (Seven and seven-tenths per cent of the strains of group R belong to Types II and IV.)

Sixteen strains of the meningococci, or 25.4 per cent of the total number, belonged to Group S. They include 11 strains of Type II, one strain related to both Types II and IV, one strain of Type I, one of Type III, and two strains not definitely related to any of the types. On the whole, therefore, group S corresponds roughly with Gordon's Ty-

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Three strains, or 4.7 per cent of the total number, belonged to group T. One of them, strain 135, is discussed at length in Butterfield and Neill's paper because it shifted its agglutinin relationship from Type I in 1918 to Type IV in 1919. One strain of group T belonged to Type II, and one strain did not agree in agglutination reactions with any of the type serums. In so far as the few strains belonging to group T indicate, the group includes various types.

One of the strains of meningococci, No. 286, belonging to Type II, showed no tropin relationship with any of the serums of groups R, S, and T. Presumably, in a larger collection strain 286 would be found to represent another distinct group. On that assumption it will be designated as belonging to group U.

The results of many absorption tests with monovalent serums, a few of which are presented in Tables VI–XI, brought out the principles already mentioned, that any typical strain of the groups R, S, and T is equal in absorption capacity to any other typical strain of the homologous group, and that the typical strains of those groups absorb none of the tropins specific for the strains of heterologous groups. If there were any exceptional strains, it seemed probable that they might be those strains whose agglutinins were of some other type than that of the majority of strains of the group to which their tropin reactions assigned them. There were six such strains of different agglutinin reaction included in groups R and S. The absorption by these strains of tropins from group R serum is given in Table XIII, and their absorption of tropins from group S serum is given in Table XIV. The data show that the strains which disagreed in their tropin and agglutinin reactions absorbed their homologous group tropins as completely as did the typical strains. This was the criterion which assigned them to their respective groups. Four of the strains (Nos. 116, 209, 306, and 265) also showed a slight absorption of tropins specific to the heterologous group. The slight cross-absorption of tropins by these four strains was the only evidence of relationship between groups R and S that was shown in all of the many tests which have been carried out. On the other hand, although the agglutination reactions of strains 114 and 307 would indicate that they should belong to some other than group R, nevertheless they are typical strains of that group in so far as their tropin absorption reactions are concerned. Strain 114 absorbed only Type II agglutinins. The absorption of agglutinin by strain 307 was not determined. It agglutinated typically with Type IV serum.

Four strains, or 6.4 per cent of the total number, belonged to group Z. All strains of this group were agglutinated by Type IV serum, but the agglutination reactions of three of them showed also a more or less close relationship with Type III.

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Group Z differs from groups R, S, and T in respect to the homogeneity of the strains which it includes. Groups R, S, and T are distinct groups standing apart, with no evidence of any tropin relationship other than that showed by the four atypical strains already discussed. On the other hand, all the strains of group Z absorb a part of the group S tropins. Three of the four strains absorbed a part of the group R serums, and two of the four absorbed a part of the group T tropins. Only two of the strains were tested against the one serum of group U. Both absorbed partially from it. The absorption of tropins by group Z strains from the group serums, including two serums of group Z, is given in Table XV. The table shows that the strains of group Z are diverse in their relationship to the other groups, and they are diverse in their relationship to one another. In fact no two strains were exactly alike. Group Z may therefore be described as consisting of strains which do not completely absorb the tropins specific for groups R, S, or T. (Absorption is called complete when it is equal to that of a typical strain of the homologous group, or in the case of group Z, it must be equal to that of the homologous strain.) But they partially absorb the group S tropins, and they may or may not partially absorb group R and group T tropins.

THE TROPIN REACTION WITHIN THE ANIMAL BODY.

It has been shown that the distinction between the various tropin groups of meningococci is marked when determined in test tube experiments. It seemed possible that these distinctions might be quantitative, and that the comparatively crude test tube method might fail to show relationships which could be shown to exist under more nearly natural conditions.

A few tropin tests were accordingly carried out within the animal body to determine this point. Guinea pigs were used for these tests. On the day preceding the test 2 c. c. of aleuronat suspension were injected into each pleural cavity. A bacterial suspension of the strains to be tested was made from 18-hour cultures on glucose serum agar. The bacterial suspension and serum were diluted in Locke's solution so that 1 c. c. contained approximately 2,000,000,000 organisms and $\frac{1}{25}$ c. c. of serum. The suspension was incubated in a 37° C. water bath for 10 minutes, and then 1 c. c. was injected into each pleural cavity. Half an hour later the guinea pig was chloroformed and smears were made from the exudate.

Two tests could be carried out in the same guinea pig. If a bacterial suspension which had been incubated with normal serum was injected into one side, and the same suspension treated with homologous immune serum injected into the other side, the microscopic [illegible] of the smears from the two sides showed a marked

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difference. All the cocci treated with immune serum were engulfed by the leucocytes of the exudate. Some of the leucocytes were packed full of meningococci, others contained a fewer number, and some showed none. No free diplococci could be found scattered in the field. In contrast to this the microscopic picture of the smear from the side into which normal serum was injected showed the cocci in pairs scattered in all parts of the field. Many leucocytes contained bacteria, some of them a goodly number, but none were full of cocci, as in the case of the immune serum. The difference in the appearance of the leucocytes in the two smears was therefore relative, but the fields outside of the leucocytes showed a marked contrast.

When the bacteria were treated with serum of a heterologous tropin group, the picture was the same as when they were treated with normal serum. The distinctions between the various tropin groups are therefore the same whether the reaction be carried out in the test tube or in the animal body.

Flexner (1907) showed that the destruction of meningococci in the guinea pig could be accomplished by fluid inflammatory exudates alone. It was of interest to compare the manner of disappearance of the meningococci in the pleural exudate with and without the influence of specific immune serum. The microscopic pictures at the end of 30 minutes have already been described. An hour after injection the two pictures were unchanged, so far as the position of the cocci was concerned, but the number of cocci had diminished in both cases. At the end of one and one-half hours the cocci had for the most part disappeared. These observations indicate that the destruction of meningococci in the pleural exudate of guinea pigs is as rapid without the influence of immune serum as with it, but that the manner of destruction in the two cases differs. After treatment with specific immune serum the dissolution takes place entirely within the leucocytes, but cocci which have not been treated with a specific immune serum disintegrate chiefly in the fluid of the exudate.

COMPARISON OF THE DEVELOPMENT OF THE AGGLUTININS AND TROPINS IN THE SERUM OF IMMUNIZED RABBITS.

In considering the relative merits of the agglutinin and tropin reactions for determining the therapeutic value of antimeningococcic serum, it is a matter of importance to know when the tropins appear and how rapidly they are produced, in respect to the appearance and production of agglutinins. Neufeld (1908) found contradictory relationships between the agglutinin and tropin content of some serums. Houston and Rankin (1907) report that a very high agglutinative power is often accompanied by a lesser degree of phagocytosis.

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Several rabbits were immunized against meningococci of different groups to follow the development of the agglutinins and the tropins. A few cubic centimeters of blood were taken just before each inoculation to determine the antibody production. The blood was kept at about 5° C. overnight and the tests for antibodies were made the following day.

Graphs illustrating the rate of agglutinin and tropin production in four rabbits are given in Chart 2. The rate of production of the two antibodies in these four rabbits indicates that when both antibodies are produced they appear at about the same time and they may increase at approximately the same rate, although the agglutinins attained a much higher titer than the tropins in the case of one of the rabbits.

The tropin content of 25 rabbit serums is given in Table VI of the accompanying paper by Butterfield and Neill, with the titer of agglutinins and complement fixation bodies in the serums. In considering this table, it should be borne in mind that a positive tropin reaction can be obtained only when the serum and antigen belong to the same group (except in the case of the strains of group Z), and that although the typical strains of any one of the groups R, S, and T are equal in their absorptive capacities to other strains of the homologous group, yet some strains are more easily ingested by the leucocytes than other strains after treatment with immune serum. Therefore the tropin content of a serum is frequently more accurately determined by the use of some other than the homologous strain.

No serum recorded in Butterfield and Neill's Table VI contains tropins in a higher dilution than 1–300. A few exceptionally good rabbit serums have been obtained with a higher titer.

Twenty-one, or 84 per cent of the 25 tested serums, showed a lower titer of tropins than of agglutinins. Only one serum (135A), or 4 per cent of the total number, showed a higher titer of tropins than of agglutinins. Three of the serums (12E, 56B, and 136B), or 12 per cent of the total number, showed no tropins, although in every case there was a good content of agglutinins and complement-fixing bodies. But one of these three serums, 12E, was tested only against the homologous strain, which is not easily phagocyted. If it had been tested against a more susceptible strain, it is likely that 12E would have shown a tropin content. The loss of tropinogenic power by strain 56 will be discussed later. Apparently some peculiarity of the rabbit producing serum 136B was responsible for the lack of tropins in this serum, for serums 136A and 136C, prepared at the same time, both contained tropins.

Table VI, to which reference has just been made, includes only serums which had a good content of agglutinins. But there are certain strains of meningococci which have poor agglutinogenic properties. Such strains nevertheless may have good tropinogenic

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properties. Strain 286 failed to produce agglutinins in two rabbits whose titer of tropins was 1–50 and 1–300, respectively.

Summarizing the data concerning the relative content of agglutinins and tropins in antimeningococcus rabbit serums, it may be stated that the majority of serums containing agglutinins will also contain tropins in lower titer. But a serum may contain agglutinins without tropins, and, on the other hand, a serum may contain tropins without agglutinins.

THE LOSS OF TROPINOGENIC POWER OF THE MENINGOCOCCUS, AND THE LOSS OF POWER TO REACT WITH SPECIFIC TROPINS.

Houston and Rankin (1907) noted that the meningococcus may lose its power of reaction (both opsonic and agglutinative) by prolonged growth on artificial media. This study confirms their observations in regard to the loss of power of tropin reaction. But more important than the power to respond to tropin reaction is the simultaneous loss of tropinogenic power. One strain in our collection has completely lost its power to stimulate tropin production in rabbits during the course of this study, and another strain has undergone a marked reduction of this power. This loss of property is deemed of sufficient importance to merit a detailed discussion.

Strain 135 was used to immunize four rabbits in September, 1918. It was a remarkably good strain for the production of tropins, and the serum of three of the rabbits showed a titer varying from 1–800 to 1–2,400. The fourth rabbit died during the immunization. Strain 135 was also particularly sensitive to phagocytosis after treatment with immune serum, and during 1918 it was constantly used as a standard antigen for test purposes. In the latter part of November, 1918, it was found to be less sensitive to phagocytic reaction, and soon after its use for test purposes had to be abandoned because it no longer showed a positive reaction after treatment with serum known to have a high specific tropin content.

In February, 1919, one of the workers of this laboratory began the passage of meningococci through mice, in an attempt to raise their virulence. Strain 135 was one of the strains chosen for this work. (See the accompanying paper, by Neill and Taft.)

The first passage was made on February 17. On March 20, after 14 mouse passages, the strain after passage was found to be more sensitive to phagocytosis than was the old stock strain after treatment with a good commercial polyvalent horse serum. On April 16, after 30 mouse passages, the difference between the passage strain and stock strain was more marked. The protocol for the test made on that day is given in Table XVI. As the data show, the old stock strain gave a questionable reaction in the 1–50 and 1–100 dilutions,

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and a negative reaction in the 1–300 dilution. The strain after passage gave a strongly positive reaction in the 1–50 and 1–100 dilutions, and a slight reaction in the 1–300 dilution.

The mouse passages were continued until June 25, when the strain had been subjected to 63 passages. The original susceptibility to phagocytosis after treatment with immune serum appeared to have been completely established, and during the course of mouse passages the strain was again used constantly for test purposes, the antigen always being made from the most recent culture after passage. The same results were always obtained in regard to specificity and susceptibility as were obtained the previous year, before the strain had undergone any change. But, on June 24, the phagocytic test with an antigen which was the second transfer after the sixty-second passage showed that again the strain had completely lost its power to respond to the tropin reaction. Similar results on June 27 with an antigen which was the second transfer after the sixty-third passage confirmed the observation. The loss of this property was sudden, for on June 20 the strain had been used for test purposes and found to be as susceptible to tropin reaction as it had ever been. It was surprising that a continuation of the treatment which had restored the original properties of the strain should have resulted in the sudden loss of those same properties.

Simultaneously with the loss of susceptibility to phagocytosis there was a loss of the tropinogenic power of strain 135, which was regained after passage through mice, as evidenced by the following experiment: After the strain had been passed through 15 mice the inoculation of rabbits for the production of immune serum was begun. The antigen used for inoculation was always the first or second transfer from the culture after the most recent passage. The inoculations were continued until after 35 mouse passages had been made. At the same time control rabbits were inoculated in the same manner with antigens made of the old-stock strain. Three rabbits were inoculated with the strain after passage, and there were three control rabbits, one of which died before any results could be obtained. The three rabbits inoculated with the strain after passage all produced tropins active toward the passage strain, but the tropin reaction of these serums with the old-stock strain was always negative. Neither of the rabbits inoculated with the old-stock strain produced tropins active for the old-stock strain nor for the passage strain. The protocols for one rabbit producing tropins and for one control rabbit are given in Table XVII.

Strain 56 exhibited a reduction of tropinogenic power. Originally strain 56 showed marked susceptibility to phagocytosis after treatment with immune serum and active tropinogenic powers. In July, [illegible] was used for the inoculation of two rabbits, both of

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which produced serum with a good titer of tropins. In September, 1918, four rabbits received inoculation of this strain, and none of them produced serums containing tropins in the 1–50 dilution. At about the same time it was observed that after treatment with immune serum, strain 56, which was being used for routine test purposes, was less readily taken up by the leucocytes than it formerly had been. Its use for test purposes was therefore discontinued. However, it never completely lost its phagocytability as did strain 135. Strain 56 was subjected to passage through mice at the same time as strain 135. But the original susceptibility to phagocytosis of strain 56 was not restored by such treatment, neither was its tropinogenic power restored. Of four rabbits inoculated with the strain after passage, all failed to produce tropins in the lowest tested dilution (1–50).[1]

Of 11 strains tested for their tropin reactions in 1918, and again about a year later, only the two mentioned strains, Nos. 135 and 56, were found to vary. Butterfield and Neill found that 3 of the 11 strains varied in their agglutination reactions. Strain 135 was one which varied in that respect, but strain 56 did not vary in its agglutination reactions. The strains which varied in agglutination reactions showed new relationships with other types at the same time that they lost their original properties. Such was not the case with the tropin reactions. There has never been observed a shifting of the relationships of a strain from group to group. The variations observed in tropin reactions were quantitative, showing a weakening, or complete loss, of the original properties.

There is an obvious practical significance to the loss of tropinogenic power of meningococci. Animals inoculated with strains which had lost their tropinogenic power might produce serum which would show a good agglutinin and complement fixation reaction, and yet contain no active tropins. Examples of such a serum may be cited. A rabbit immunized by Mr. Butterfield against strain 56 after its tropinogenic power had weakened gave agglutinin and complement fixation in high titer. (See Table VI in the accompanying paper by Butterfield and Neill.)

Two horses, Nos. 817 and 827, inoculated for experimental purposes at the laboratory of the New York City department of health, produced serums which serve as examples of the result obtained with horses when strains are used which possess weak tropinogenic powers. The horses were inoculated at intervals during several months with increasing doses of antigen. Horse 817 was inoculated with strain 135, horse 823 was inoculated with strain 136, and horse 827 was inoculated with both strains. After every bleeding samples of the

[1] Several rabbits immunized with strain 56 at a later date showed tropins in a dilution of 1:10.

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serum were forwarded to the Hygienic Laboratory. A summary of the protocols for the three horses is given in Table XVIII.

Horses 823 and 827, receiving inoculations with strain 136, produced serums containing tropins active against group S strains in the 1–80 dilution on the one hundred and twenty-eighth day after the first inoculation, and they maintained this titer with slight variations during several months of continued inoculations. During the whole course of the experiment horse 823 showed no tropins active toward strains of group R.

At the time of testing the earlier bleedings the tropin groups as represented in Table XII had not been recognized. Moreover, the only information at hand regarding the strains used for inoculation was that horses 817 and 827 were receiving a Gordon's Type I strain and that horses 823 and 827 were receiving a Gordon's Type II strain. The serums were tested for tropins against strain 123 representing Type I, strain 55 representing Type II, and strain 57 representing Type III. In the light of the information now at hand it should not have been expected that any of the horses would develop tropins active against the group R strains (Nos. 123 and 57), because the Type I strain used for immunization was strain 135, belonging to Group T. The tables show occasional positive results in the 1–50 or 1–100 dilution when negative results were to have been expected. The reaction giving these positive results was always slight, indicated by a comparatively low phagocytic index. The slight reactions in low dilutions of the serum can be explained by the fact that the serum for testing was always fresh, and no preservative had been added. The occasional positive reactions in low dilutions were therefore probably due to the normal opsonins. But at the time of the testing it was not known that unpreserved serums were being dealt with, consequently a preserved normal serum was used for a control, which gave a negative reaction.

As compared with the good titer of group S tropins in the serum of horses inoculated with strain 136, the occasional low titer of group R tropins in serums 817 and 827 was surprising. Considering the possibility that the strain used for inoculating these horses might belong to group T, the serums received during the period of mouse passage, when strain 135 exhibited its rejuvenated properties, were tested for tropins specific to that strain. But none were demonstrated in any of the tests. The failure to produce tropins active for group T strains can not be attributed to peculiarities of the horses, for horse 827, which also received a group S strain, produced tropins active for strains of that group. The only apparent explanation is satisfactory, namely, that strain 135 had lost its tropinogenic powers under the cond[illegible] of culture in the New York City laboratory in the same

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manner as did our subculture, obtained from the New York City laboratory three months before the first inocculation of the horses.

After the first three or four months the serum from all three horses contained high titers of agglutinins specific for the types with which they were inoculated. The complement fixation titer of the serum from all three horses was also high for the specific types used for inoculation, according to the data obtained for the last two bleedings.

These experiments illustrate how serums might be produced for therapeutic purposes which would have a satisfactory content of agglutinins, but which would be deficient in their tropin content. The results indicate that cultures which have been maintained for a long time under artificial cultivation can not always be depended upon to produce serum containing tropins. On the other hand, two strains belonging to group R (Nos. 11 and 12) each produced a good titer of tropins in rabbits three years after their isolation, as shown by our experiments. It is probable that different strains may vary considerably in the length of time they can be cultivated on agar without a loss of their tropinogenic powers.

THE TROPIN CONTENT OF COMMERCIAL ANTIMENINGOCOCCUS SERUMS.

It has been shown that a good content of agglutinin indicates, in the majority of experimental rabbit serums, a good tropin content. But the one antibody has been shown to exist in high titer without the other in both rabbit and horse serums prepared for experimental purposes. The relative content of agglutinins and tropins in commercial serums remains to be considered.

The content of agglutinins and tropins has been determined for 128 samples of commercial serums which were sent to the Hygienic Laboratory from the various manufacturing firms for the routine agglutination and complement fixation tests always made before a serum is placed on the market. The serums were tested for their tropin content within a few days after they were received at the laboratory, and the results were compared with the results of the routine agglutination test.

The testing of commercial serum for tropins was done before the classification of strains had been completely worked out. Hence the choice of strains used for the testing was made on the basis of the agglutinin types instead of on the basis of the tropin groups, as it would now be made. For the tropin tests the strain representing Type I was No. 153 for 77 serums, and No. 123 for the remaining 57 serums. Strain 55 represented Type II, and strain 57 represented Type III. Later studies revealed the fact that the same specific (group R) tropins were measured by the use of the strains of Types I and III. Therefore in this discussion only the data obtained for the Type I strains will be considered.

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A tentative standard for the tropin content of the commercial serums was assumed, in order to compare the test with the agglutinin test. No serum was considered passable unless it showed a distinctly positive reaction for groups R and S in the 1–100 dilution. According to such a standard approximately the same number of serums would be rejected as were actually rejected by the agglutinin test.

Judged by the official agglutinin test 29, or 22.6 per cent, of the 128 serums were rejected. Judged by the presumptive tropin test. 31, or 24.2 per cent, of the serums would have been rejected. But only 12, or 9.3 per cent, failed in both tests, and 80, or 62.5 per cent, of the serums would have passed both tests. For the remaining 36 serums, or 28.2 per cent of the total number, the tropin and agglutinin tests were contradictory. Some of these were near the border line on the side of the good serums according to the one test, and just over the line on the side of the poor serums according to the other test. On the other hand, there were a few serums which showed an exceptionally good tropin content, but which failed to pass the agglutinin test, and there were a few serums which agglutinated in high titer which showed a very poor content of tropins. Chart 3 shows the relationship between the tropins and agglutinins in the 128 commercial serums.

When the 128 commercial serums were tested for tropins group T had not yet been recognized, consequently the content of group T tropins in these serums is unknown. But serums from all the commercial firms have since been tested against group T strains, and all were found to contain the specific group T tropins. Strains of this group were therefore shown to be well distributed among the manufacturers, although they form a very small percentage of our collection. Commercial serums with a good content of group R and group S tropins were generally satisfactory also in their content of group T tropins.

Serums from six of the eight firms manufacturing antimeningococcus serum have been tested against strain 286, which showed no relationship to the three main groups of meningococci R, S, and T. None of the tested serums contained tropins specific for strain 286. It has been sent to every firm manufacturing antimeningococcus serum with the recommendation that it be included among the antigens used for serum production.

It would be an unnecessary duplication of effort to test the polyvalent serums against a representative of group Z, because the strains of this group give a positive phagocytic reaction with group S tropins, and some of them give a positive reaction with group R and group T tropins. Hence a commercial serum satisfactory in its content of tropins specific for those three groups would give a positive reaction with [illegible] group Z strains.

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According to our present knowledge of tropins, therefore, a satisfactory commercial serum should contain a good titer of tropins active against some one strain representing each of the groups R, S, and T, and it should also contain tropins active against strain 286.

THE DETERIORATION OF TROPINS IN ANTIMENINGOCOCCUS SERUM.

The results with several experimental serums have shown that when subjected to unfavorable conditions the agglutinins may be destroyed leaving the tropins uninjured, or, on the other hand, the tropins may be destroyed leaving the agglutinins uninjured.

The serum from horse 823 was heated for 30 minutes to temperatures varying from 55° to 65° C. and then tested for agglutinins and tropins against antigen 55. The protocols for duplicate tests are given in Table XIX. The tropin reactions showed the highest titer to be consistently lower in the second test. Otherwise the results of the duplicate tests were similar. Neither the agglutinins nor the tropins were appreciably injured at 55°. The serum heated to 60° gave no agglutination reaction, but the tropins were scarcely injured at that temperature. The serum heated to 65° showed a positive phagocytic reaction only in one dilution (1–500 in the first test and 1–200 in the second test). Although there was no agglutination reaction in the serum heated to 60°, it is quite remarkable that a good agglutination was obtained in the higher dilutions of serum heated to 65°. This paper does not concern itself with agglutinins, except in their relationship to tropins, therefore this interesting phenomenon is noted without other comment than a reference to Dreyer's (1904) report of similar observations. The point of interest in connection with the subject under discussion is that in the serum heated to 60° no agglutinins could be demonstrated, whereas the tropins could be unmistakably demonstrated in dilutions to 1–800 in the first test, and to 1–300 in the second test.

A sample of rabbit serum immunized against strain 56 was divided into two portions and kept without preservative, one portion at about 6° C. and the other portion at about 15° C. The agglutinin and tropin content was determined in the fresh serum and again after it had been kept for 43 days. The serum kept at 15° C. was contaminated with a small colony of mold. No tropins could be demonstrated in it. The tropins in the serum kept at 6° C. deteriorated somewhat. But the activity of the agglutinins remained unchanged in both samples of serum.

A monovalent rabbit serum immunized against strain 55 contained agglutinins in the 1–800 dilution at the time it was drawn. It was preserved with 0.2 per cent tricresol and kept at about 15° C. The tropin content was not determined until three months later, when tropins were demonstrated in the 1–300 dilution. When the serum

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was about 5 months old the tropins had disappeared, although they are ordinarily retained longer in serums kept under those conditions. The agglutinin content, however, was the same at the end of the 5 months as it was in the freshly drawn serum.

The deterioration of tropins in commercial antimeningococcus serums kept at a temperature of about 15° C. is being determined on 10 samples of serum from various manufacturing firms. The bottles are opened and tested once in two months. At the time of this writing the serums have been held for 8 months. As yet the majority of the serums have not shown a notable deterioration, although at least 3 of them show a decline in tropin content for either one or the other of the two groups of meningococci (R and S) which were represented in the test.

THE PROBLEM OF THE IDENTITY OF AGGLUTININS AND TROPINS.

It has been a controverted point as to whether the bacteriotropins and agglutinins are identical. In a very recent paper Tulloch (1919) states that the agglutinin titer and the phagocytic titer of antitetanus serum are independent one of another. In discussing the identity of agglutinins and bacteriotropins, Zinsser states that the supposition that they are identical has found no experimental support, in that agglutination and bacteriotropic effects do not run parallel. But he does not admit that such lack of parallelism is proof against their identity. However that may be, the study of meningococcic agglutinins and tropins has shown that it is not uncommon to obtain the characteristic effect of the one antibody without the other. Agglutination without phagocytosis is shown in Figure 2.

DOES THE TROPIN TEST MEASURE THE THERAPEUTIC VALUE OF ANTIMENINGOCOCCUS SERUM?

The tropin test carried out according to the method here described is a workable test. Specific serums are distinguished unequivocally from either normal or from nonspecific immune serums. Results are as consistent as could be expected in such a complicated biological test. In Table XX are given the results obtained for the tropin content of a commercial serum used for a positive control in 10 consecutive tests.

Ultimate judgment of the value of the test as applied to serum intended for treatment of meningitis will depend upon clinical observations of the effect of serums of known tropin content and divergent titers of other antibodies.

Meanwhile animal experiments may throw some light on the amount of cross protection there is between the groups. Such experiments are being carried out and will be reported in a forthcoming

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SUMMARY.

The phagocytic test for bacteriotropins is a workable test which distinguishes clearly between a normal serum and a serum containing the specific antibodies.

The important phagocytic antibodies in meningococcus serum are bacteriotropins. That is, they are not dependent upon complement for their activity.

A high concentration of tropins does not inhibit phagocytic action, but there is in serum a poisonous substance active against leucocytes of a foreign species, which suppresses phagocytic activity in low dilutions of the serum.

No strains of meningococci were found which resisted phagocytosis after treatment with serum containing the specific tropins.

All strains of meningococci tested produced tropins in inoculated rabbits. But not every inoculated rabbit produced tropins, presumably because of individual differences in the animals. Some strains regularly produced tropins in higher titer than other strains.

After long artificial cultivation meningococci may lose their tropinogenic power, and their power to respond to active tropins.

The tropin reactions of meningococci are specific, dividing them into well-defined groups, with no cross reaction between the typical strains of the main groups.

Sixty-three strains of meningococci were available for classification according to their tropin reactions. They were divided into 4 distinct groups, designated R, S, T, and U.

Group R included 61.9 per cent of the strains; group S included 25.4 per cent of the strains; group T included 4.7 per cent of the strains, and group U included 1.6 per cent of the strains.

Groups R, S, T, and U are distinct groups. Every strain belonging to those groups was equal to every other strain of the homologous group in its power of absorbing tropins from serums of the homologous group. The typical strains of groups R, S, T, and U did not absorb tropins specific to a heterologous group. But 4 atypical strains were found which did, in a slight degree, absorb tropins of another group.

A fifth group, Z, included 6.4 per cent of the total number of strains of meningococci. Unlike the other four groups, group Z is not distinct, but is related to the others. This relationship is shown by a partial absorption of tropins specific for those groups. Moreover, the strains of group Z differ in their relationship to one another, and they differ in their relationship to the 4 main groups. The strains of group Z are further distinguished by a tendency to spontaneous phagocytosis.

In the majority of immune serums a good tropin content is accompanied by a good agglutinin content. But agglutinins may be

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produced without tropins, and tropins may be produced without agglutinins.

Under unfavorable conditions the deterioration of agglutinins and tropins did not follow a parallel course. Certain conditions destroyed the action of the agglutinins without injuring the tropins, and other conditions destroyed the action of the tropins without injuring the agglutinins.

One hundred and twenty-eight commercial serums were tested for their content in tropins. The tropin content was compared with the agglutinin content as determined in the official test. The results of the two tests agreed for 71.8 per cent of the serums. For the remaining 28.2 per cent the results were discordant.

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Camera lucida drawings.

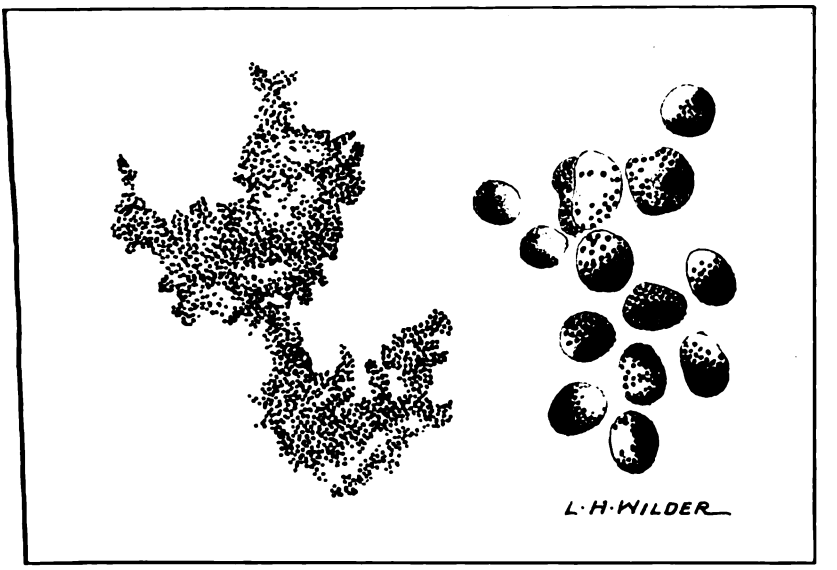

FIG. 1.—PHAGOCYTOSIS OF MENINGOCOCCI AFTER TREATMENT WITH IMMUNE SERUM.

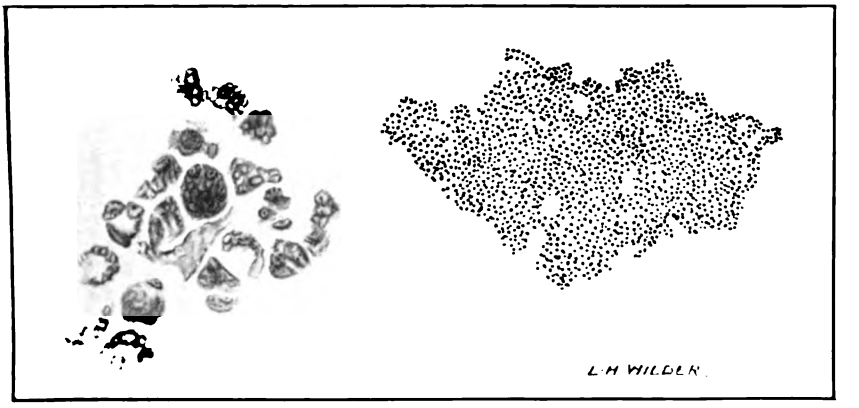

FIG. 2.—AGGLUTINATION OF MENINGOCOCCI WITHOUT PHAGOCYTOSIS.

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TABLE I.—*Illustration of the protocols, with in terpretation of results.*

	Locke's solution.	Normal rabbit serum.		Immune serum.				
		1–50	1–100	1–50	1–100	1–300	1–500	1–800
a. Percentage of phagocyting cells....	0	12	8	72	48	36	.....	.....
Percentage of filled cells.....	.....	0	0	20	8	0	.....	.....
b. Percentage of phagocyting cells....	12	40	28	92	68	68	84	32
Percentage of filled cells.....	0	8	4	60	28	40	56	4
c. Percentage of phagocyting cells....	60	40	56	.....	.....	.....	.....	.....
Percentage of filled cells.....	0	16	4	.....	.....	.....	.....	.....

a. Tropin in the serum of a rabbit immunized with strain 135, tested against the homologous antigen. The figures for Locke's solution and normal rabbit serum are such as are commonly obtained. There is a distinct positive reaction in the 1–50 and 1–100 dilutions, and a slight reaction in the 1–300 dilution.

b. Tropin in the serum of a rabbit immunized with strain 138, tested against the homologous antigen. Strain 138 is one of the few which regularly showed phagocytosis in the normal serum. But the very high figures obtained for the immune serum in dilutions up to 1–500 indicate a distinctly positive reaction. The reaction in the 1–800 dilution is negative.

c. Spontaneous phagocytosis. When the negative controls give such figures the test must be discarded.

TABLE II A.—*Effect of the additon of complement to commercial serum.*

Serum.	Serum without complement.			Serum with complement.[1]		
	1–50	1–100	1–300	1–50	1–100	1–300
Normal horse	[2] 12	8	.....	0	0	.....
	[3] 0	0	.....	.....	.....	.....
712	.....	84	44	.....	.....	36
	.....	56	12	.....	.....	24
180	.....	56	64	.....	56	24
	.....	28	24	.....	52	0
183	.....	56	20	.....	52	8
	.....	52	0	.....	32	0
184	.....	44	24	.....	56	16
	.....	28	0	.....	44	0
185	.....	56	16	.....	64	0
	.....	52	8	.....	56	.....
715	.....	56	0	.....	68	20
	.....	36	.....	.....	36	12

Strain 123 was the antigen used in these tests.

[1] The dilution of complement was 1-300 in all dilutions of immune serum.
[2] The upper figures refer to the percentage of phagocyting leucocytes.
[3] The lower figures refer to the percentage of filled cells.

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TABLE II B.—*Effect of the addition of complement to commercial serum.*

	Locke's solution.	Normal horse serum.		Commercial serum.			
		1–50	1–100	1–50	1–100	1–150	1–200
Serum alone	0	[1] 12	0	40	32	24	12
		[2] 0		32	12	4	0
Serum and complement [3]				48	24	20	8
				36	12	8	0

Strain 55 was the antigen used in these tests.

[1] The upper figures refer to the percentage of phagocyting cells.
[2] The lower figures refer to the percentage of filled cells.
[3] One part of guinea pig complement was added to 9 parts immune serum before dilution.

TABLE III A.—*Phagocytic activity in fresh, heated, and unheated antimeningococcus rabbit serum.*[1]

Rabbit No.	Serum.	Dilutions.				
		1–50	1–100	1–200	1–400	1–600
	Normal	[2] 4	0			
		[2] 0				
75	Unheated		60	36	8	
			40	12	0	
	Heated		56	16	12	
			40	8	0	
78	Unheated		52	44	8	
			44	28	0	
	Heated			44	8	
				20	0	
79	Unheated		76	12		
			36	0		
	Heated		52	12		
			36	0		
80	Unheated		60	12	0	
			40	8		
	Heated		48	8		
			16	0		
81	Unheated			64	12	
				40	0	
	Heated		52	36	0	
			32	8		
82	Unheated			44	20	
				24	0	
	Heated		44	36	12	
			24	20	0	
83	Unheated				44	8
					28	0
	Heated				56	8
					32	0

Strain 57 was used as an antigen in these tests.

[1] The rabbits were immunized with strains 153 and 154.
[2] The upper figure refers to the percentage of phagocyting leucocytes.
[3] The lower figure refers to the percentage of filled leucocytes.

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TABLE III B.—*Phagocytic activity in heated and unheated antimeningococcus rabbit serum.*[1]

Rabbit No.	Serum.	Dilutions. 1–50	1–100	1–500	1–200
	Normal	[2] 4 / [3] 0	0	.....	.....
191	Unheated	32	16	.....	.....
	Heated	4	0	.....	.....
	Unheated	36	12	.....	.....
	Heated	8	0	.....	.....
192	Unheated	.....	64	8	.....
	Heated	.....	16	0	.....
	Unheated	.....	44	8	.....
	Heated	.....	16	0	.....
193	Unheated	.....	64	32	8
	Heated	.....	16	4	0
	Unheated	.....	44	32	0
	Heated	.....	8	4	.....
194	Unheated	.....	.....	32	16
	Heated	.....	.....	12	0
	Unheated	.....	.....	44	16
	Heated	.....	.....	12	0
196	Unheated	.....	44	12	.....
	Heated	.....	8	0	.....
		.....	32	8	.....
		.....	8	0	.....

Strain 289 was used as an antigen in these tests.

[1] The rabbits were immunized with strain 289.
[2] The upper figure refers to the percentage of phagocyting leucocytes.
[3] The lower figure refers to the percentage of filled leucocytes.

TABLE IV.—*The effect of low dilutions of serum on phagocytic action.*

	Locke's solution.	Serum dilutions. 1–3	1–6	1–10	1–20	1–30	1–40	1–50	1–100	1–300	1–500	1–800
Normal rabbit serum[1]	0	0	[2] 4 / [3] 0	0	4 / 0	0	0	.....	.....	.....	.....	.....
Antimeningococcus rabbit serum 57 C_2.[4]	.....	80	56	64	76	72	68	76	68	84	48	0
	.....	40	20	28	36	28	36	44	36	28	24	.....
Normal horse serum[5]	0	4	20	12	24	16	8	.....	.....	.....	.....	.....
	.....	0	0	0	0	0	0	.....	.....	.....	.....	.....
Antimeningococcus commercial serum (horse).	.....	8	28	16	56	64	60	56	44	16	.....	.....
	.....	0	4	0	28	16	16	24	32	0	.....	.....

Strain 57 was used for these tests.

[1] The normal rabbit serum had been preserved with 0.25 per cent phenol for several days.
[2] The upper figures refer to the percentage of phagocyting leucocytes.
[3] The lower figures refer to the percentage of filled leucocytes.
[4] Rabbit serum immunized against strain 57.
[5] The normal horse serum was fresh, having been drawn only a couple of hours before using. Apparently it contained some normal opsonins, resulting in a slight phagocytosis.

TABLE V.—*Cross reactions between monovalent serums and antigens of homologous and heterologous types.*

Antigen.	Type.	Type I serum. 135	123	11	50	98	153	154	287	Type II serum. 55	56	58	59	104	136	Type III serum. 57	106	110	Type IV serum. 138	60
135	I	+	−	−	−	−	.....	−	−	−	−	−	.....	.....	−	−	−	.....	.....	+
123	I	−	+	+	+	+	+	+	+	−	.....	−	.....	.....	−	+	+	+	−	−
55	II	−	−	−	−	−	.....	−	−	+	+	+	+	+	+	−	−	−	+	−
57	III	−	+	+	+	+	+	+	+	−	−	−	−	−	−	+	+	+	−	−
138	IV	+	−	−	−	−	.....	−	−	+	+	+	−	−	+	−	−	−	+	+

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TABLE II B.—*Effect of the addition of complement to commercial serum.*

	Locke's solution.	Normal horse serum.		Commercial serum.			
		1–50	1–100	1–50	1–100	1–150	1–200
Serum alone	0	[1] 12	0	40	32	24	12
		[2] 0		32	12	4	0
Serum and complement [3]				48	24	20	8
				36	12	8	0

Strain 55 was the antigen used in these tests.

[1] The upper figures refer to the percentage of phagocyting cells.
[2] The lower figures refer to the percentage of filled cells.
[3] One part of guinea pig complement was added to 9 parts immune serum before dilution.

TABLE III A.—*Phagocytic activity in fresh, heated, and unheated antimeningococcus rabbit serum.*[1]

Rabbit No.	Serum.	Dilutions.				
		1–50	1–100	1–200	1–400	1–600
	Normal	[2] 4	0			
		[3] 0				
75	Unheated		60	36	8	
			40	12	0	
	Heated		56	16	12	
			40	8	0	
78	Unheated		52	44	8	
			44	28	0	
	Heated			44	8	
				20	0	
79	Unheated		76	12		
			36	0		
	Heated		52	12		
			36	0		
80	Unheated		60	12	0	
			40	8		
	Heated		48	8		
			16	0		
81	Unheated			64	12	
				40	0	
	Heated		52	36	0	
			32	8		
82	Unheated			44	20	
				24	0	
	Heated		44	36	12	
			24	20	0	
83	Unheated				44	8
					28	0
	Heated				56	8
					32	0

Strain 57 was used as an antigen in these tests.

[1] The rabbits were immunized with strains 153 and 154.
[2] The upper figure refers to the percentage of phagocyting leucocytes.
[3] The lower figure refers to the percentage of filled leucocytes.

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TABLE III B.—*Phagocytic activity in heated and unheated antimeningococcus rabbit serum.*[1]

Rabbit No.	Serum.	Dilutions. 1–50	1–100	1–500	1–200
	Normal	[2] 4	0	.....	.....
		[3] 0	.....	.....	.....
191	Unheated	32	16	.....	.....
		4	0	.....	.....
	Heated	36	12	.....	.....
		8	0	.....	.....
192	Unheated	.....	64	8	.....
		.....	16	0	.....
	Heated	.....	44	8	.....
		.....	16	0	.....
193	Unheated	.....	64	32	8
		.....	16	4	0
	Heated	.....	44	32	0
		.....	8	4	.....
194	Unheated	.....	.....	32	16
		.....	.....	12	0
	Heated	.....	.....	44	16
		.....	.....	12	0
196	Unheated	.....	44	12	.....
		.....	8	0	.....
	Heated	.....	32	8	.....
		.....	8	0	.....

Strain 289 was used as an antigen in these tests.

[1] The rabbits were immunized with strain 289.
[2] The upper figure refers to the percentage of phagocyting leucocytes.
[3] The lower figure refers to the percentage of filled leucocytes.

TABLE IV.—*The effect of low dilutions of serum on phagocytic action.*

	Locke's solution.	Serum dilutions. 1–3	1–6	1–10	1–20	1–30	1–40	1–50	1–100	1–300	1–500	1–800
Normal rabbit serum[1]	0	0	[2] 4	0	4	0	0	.....	.....	.....	.....	.....
	.....	.....	[3] 0	.....	0	.....	.....	.....	.....	.....	.....	.....
Antimeningococcus rabbit serum 57 C_2.[4]	.....	80	56	64	76	72	68	76	68	84	48	0
	.....	40	20	28	36	28	36	44	36	28	24	.....
Normal horse serum[5]	0	4	20	12	24	16	8	.....	.....	.....	.....	.....
	.....	0	0	0	0	0	0	.....	.....	.....	.....	.....
Antimeningococcus commercial serum (horse).	.....	8	28	16	56	64	60	56	44	16	.....	.....
	.....	0	4	0	28	16	16	24	32	0	.....	.....

Strain 57 was used for these tests.

[1] The normal rabbit serum had been preserved with 0.25 per cent phenol for several days.
[2] The upper figures refer to the percentage of phagocyting leucocytes.
[3] The lower figures refer to the percentage of filled leucocytes.
[4] Rabbit serum immunized against strain 57.
[5] The normal horse serum was fresh, having been drawn only a couple of hours before using. Apparently t contained some normal opsonins, resulting in a slight phagocytosis.

TABLE V.—*Cross reactions between monovalent serums and antigens of homologous and heterologous types.*

Antigen.	Type.	Type I serum. 135	123	11	50	98	153	154	287	Type II serum. 55	56	58	59	104	136	Type III serum. 57	106	110	Type IV serum. 138	60
135	I	+	−	−	−	−	....	−	−	−	−	−	.....	.....	−	−	−	.....	.....	+
123	I	−	+	+	+	+	+	+	+	−	....	−	.....	.....	−	+	+	+	−	−
55	II	−	−	−	−	−	....	−	−	+	+	+	+	+	+	−	−	−	+	−
57	III	−	+	+	+	+	+	+	+	−	−	−	−	−	−	+	+	+	−	−
138	IV	+	−	−	−	−	....	−	−	+	+	+	−	−	+	−	−	−	+	+

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TABLE VI.—*Absorption of tropins from rabbit serum 135 (Type I).*

	Serum dilutions.		
	1–50	1–100	1–300
Negative control, normal serum	[1] 12	8	.....
	[2] 0	0	.....
Positive control, not absorbed	68	60	28
	44	4	0
Absorbed by antigen 135 (Type I)	36	12	8
	4	0	0
Absorbed by antigen 123 (Type I)	68	48	24
	28	0	0
Absorbed by antigen 55 (Type II)	56	64	48
	36	12	0
Absorbed by antigen 203 (Type III)	80	48	24
	32	0	0
Absorbed by antigen 138 (Type IV)	72	44	28
	32	4	0

The serum was tested against strain 135 (Type I).
All antigens were of a turbidity of 3,000 parts per million.

[1] The upper figure refers to the percentage of phagocyting leucocytes.
[2] The lower figure refers to the percentage of filled leucocytes.

TABLE VII.—*Absorption of tropins from rabbit serum 123 (Type I).*

	Serum dilutions.		
	1–50	1–100	1–300
Negative control, normal serum	0	0	.....
	.....	.....	.....
Positive control, not absorbed	[1] 88	84	8
	[2] 68	44	0
Absorbed by antigen 135 (Type I)	76	76	0
	72	52	.....
Absorbed by antigen 123 (Type I)	4	0	4
	0	.....	0
Absorbed by antigen 281 (Type I)	4	0	0
	0	.....	.....
Absorbed by antigen 55 (Type II)	68	84	4
	40	44	0
Absorbed by antigen 203 (Type III)	4	4	4
	0	0	0
Absorbed by antigen 138 (Type IV)	88	84	12
	84	56	0

The serum was tested against strain 123 (Type I).
All antigens were of a turbidity of 2,000 parts per million.

[1] The upper figure refers to the percentage of phagocyting leucocytes.
[2] The lower figure refers to the percentage of filled leucocytes.

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TABLE VIII.—*Absorption of tropins from horse serum 823, immunized against strain 136 (Type II).*

	Serum dilutions.					
	1–50	1–100	1–300	1–500	1–800	1–1200
Negative control, normal serum	[1] 4 [2] 0	4 0	.....	.....	.....	.....
Positive control, not absorbed	.....	.....	.....	64	48	16
	.....	.....	.....	36	0	0
Absorbed by antigen 153 (Type I) [3]	.....	.....	.....	40	44	8
	.....	.....	.....	24	16	0
Absorbed by antigen 55 (Type II)	20	12	0	8	.....	.....
	4	8	.....	0	.....	.....
Absorbed by antigen 57 (Type III)	.....	.....	.....	56	52	20
	.....	.....	.....	40	16	0
Absorbed by antigen 138 (Type IV)	.....	64	44	16	.....	.....
	.....	32	16	0	.....	.....

The serum was tested against strain 55 (Type II).
All antigens were of a density of 7,200 parts per million.

[1] The upper figure refers to the percentage of phagocyting leucocytes.
[2] The lower figure refers to the percentage of filled leucocytes.
[3] Strain 153 represents the same group of Type I meningococci as strain 123. (See Table VII.)

TABLE IX.—*Absorption of tropins from rabbit serum 57 (Type III).*

	Serum dilutions.		
	1–50	1–100	1–300
Negative control, normal serum	0	[1] 4 [2] 0	.....
Positive control, not absorbed	52	40	16
	36	12	0
Absorbed by antigen 153 (Type I)	0	8	.....
	.....	0	.....
Absorbed by antigen 55 (Type II)	48	40	4
	28	12	0
Absorbed by antigen 57 (Type III)	4	12	.....
	0	0	.....
Absorbed by antigen 93 (Type III)	20	0	.....
	0	.....	.....
Absorbed by antigen 138 (Type IV)	48	56	8
	40	4	0

The serum was tested against strain 57 (Type III).
All antigens were of a turbidity of 1,000 parts per million.

[1] The upper figure refers to the percentage of phagocyting leucocytes.
[2] The lower figure refers to the percentage of filled leucocytes.

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TABLE X.—*Absorption of tropins from rabbit serum 138 (Type IV).*

	Serum dilutions.				
	1–50	1–100	1–300	1–500	1–800
Negative control, normal serum	[1] 28	20	.....	.....	.....
	[2] 4	0	.....	.....	.....
Positive control, not absorbed	88	84	80	64	36
	52	56	28	8	0
Absorbed by antigen 135 (Type I) [3]	72	52	24	20	32
	56	28	4	0	0
Absorbed by antigen 123 (Type I) [4]	92	68	68	84	.....
	60	28	40	56	.....
Absorbed by antigen 55 (Type II) [3]	28	56	56	24	20
	16	16	8	0	0
Absorbed by antigen 57 (Type III) [4]	92	68	80	72	.....
	68	24	32	32	.....
Absorbed by antigen 138 (Type IV) [3]	4	12	8	12	4
	0	0	0	0	0
Absorbed by antigen 298 (Type IV) [4]	40	20	12	32	.....
	4	0	0	4	.....
Absorbed by antigen 60 (Type IV) [3]	64	68	16	36	4
	36	44	0	0	0

The serum was tested against strain 138.

[1] The upper figure refers to the percentage of phagocyting leucocytes.
[2] The lower figure refes to the percentage of filled leucocytes.
[3] Antigens were of a turbidity of 4,800 parts per million.
[4] Antigens were of a turbidity of 2,100 parts per million.

TABLE XI.—*Classification of strains by absorption from a polyvalent horse serum.*

	Antigen 123 (group R) Serum dilutions.			Antigen 55 (group S) Serum dilutions.			Antigen 135 (group T) Serum dilutions.		
	1–50	1–100	1–300	1–50	1–100	1–300	1–50	1–100	1–300
Normal serum	[1] 16	4	.....	0	4	.....	12	12	.....
	[2] 0	0	.....	.....	0	.....	0	0	.....
Not absorbed	80	96	76	52	80	28	92	80	84
	68	88	64	48	72	16	72	68	52
Absorbed by antigen 134 [3]	12	12	12	88	72	56	64	76	72
	0	0	0	84	72	20	40	76	16
Absorbed by antigen 128 [4]	84	84	76	0	0	0	88	80	60
	64	68	52	.....	.....	.....	72	76	44
Absorbed by antigen 298 [5]	100	80	84	76	32	0	84	80	60
	100	76	84	72	32	.....	68	72	32
Absorbed by antigen 303 [6]	84	84	96	84	76	40	12	12	4
	76	80	72	72	56	8	0	0	0

All absorbing antigens were of a turbidity of 3,000 parts per million.

[1] The upper figures refer to the percentage of phagocyting cells.
[2] The lower figures refer to the percentage of filled cells.
[3] Strain 134 is shown to belong to group R.
[4] Strain 128 is shown to belong to group S.
[5] By its partial absorption of group S tropins, as compared with antigen 128, strain 298 is shown to belong to group Z.
[6] Strain 303 is shown to belong to group T.

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TABLE XII.—*The grouping of 63 strains.*

Group R.				Group S.		Group T.		Group U.		Group Z.	
Strain No.	Type.	Strain No.	Type.	Strain No.	Type.	Strain No.	Type.	Strain No.	Type.	Strain No.	Type.
6	III	154	I	55	II	135	I, IV	.....	.....	60	IV
10	I	203	III	56	II	289	(1)	286	II	138	III, IV
11	I	205	III	58	II	303	II	.....	.....	298	III, IV
12	I	.....	.....	59	II	.....	.....	.....	.....	304	[2] III
50	I	211	III	104	II	.....	.....	.....	.....	.....	.....
52	I	265	[3] II	116	(1)	.....	.....	.....	.....	.....	.....
57	III	273	I	128	(1)	.....	.....	.....	.....	.....	.....
93	III	280	I	136	II	.....	.....	.....	.....	.....	.....
98	I, III	281	I	209	III	.....	.....	.....	.....	.....	.....
106	III	282	I	274	II	.....	.....	.....	.....	.....	.....
110	III	283	I	290	II, IV	.....	.....	.....	.....	.....	.....
114	II	284	I	294	II	.....	.....	.....	.....	.....	.....
120	I	287	I	300	[3] II	.....	.....	.....	.....	.....	.....
123	I	291	III	301	II	.....	.....	.....	.....	.....	.....
124	I	292	I	306	I	.....	.....	.....	.....	.....	.....
126	I	293	I	308	II	.....	.....	.....	.....	.....	.....
134	III, IV	295	III	.....	.....	.....	.....	.....	.....	.....	.....
140	I	296	III	.....	.....	.....	.....	.....	.....	.....	.....
150	I	302	III	.....	.....	.....	.....	.....	.....	.....	.....
153	I	307	IV	.....	.....	.....	.....	.....	.....	.....	.....

[1] Indefinite.
[2] Strain 304 was also agglutinated by serums of Types I and IV, but it does not absorb agglutinins from those serums.
[3] Absorption test only suggestive with type serums indicated.

TABLE XIII.—*Absorption of tropins from group R serum by strains whose tropin and agglutinin reactions disagree.*

	Absorbing antigen belonged to—		Serum dilutions.				
	Group.	Type.	1-50	1-100	1-300	1-500	1-800
Negative control, normal serum.	.....	.....	[1] 8 [2] 0	.....	.....	.....	.....
Positive control, not absorbed..	.....	.....	76 44	68 36	84 28	48 24	0 .....
Absorbed by antigen 123 [3].....	R	I	8 0	0	0	.....	.....
Absorbed by antigen 114.....	R	II	4 0	0	4 0	0	.....
Absorbed by antigen 265.....	R	II	0	0	8 0	.....	.....
Absorbed by antigen 307.....	R	IV	20 0	8 0	4 0	4 0	.....
Absorbed by antigen 116.....	S	(4)	60 24	40 12	36 4	8 0	.....
Absorbed by antigen 209.....	S	III	72 24	48 32	56 28	16 0	.....
Absorbed by antigen 306.....	S	I	72 60	60 36	76 36	16 0	.....

The serum used in this test was a rabbit serum immunized against strain 57.
The absorbed serum was tested against strain 57.
The absorbing antigens were of a turbidity of 5,700 parts per million.

[1] The upper figures refer to the percentage of phagocyting cells.
[2] The lower figures refer to the percentage of filled cells.
[3] The serum was absorbed by antigen 123, which was a typical strain belonging to group R and Type I, in order that the absorbing power of the other strains might be compared with it.
[4] Indefinite.

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TABLE XIV.—*Absorption of tropins from group S serum by strains whose tropin and agglutinin reactions disagree.*

	Absorbing antigen belonged to—		Serum dilutions.					
	Group.	Type.	1–50	1–100	1–300	1–500	1–800	1–1200
Negative control normal serum			[1] 4	0				
			[2] 0					
Positive control not absorbed			44	48	44	84	36	4
			28	32	20	28	8	0
Absorbed by antigen 55 [3]	S	II	32	4	4	0	0	
			4	0	0			
Absorbed by antigen 114	R	II	52	48	56	52	20	
			36	32	32	20	8	
Absorbed by antigen 265	R	II	60	76	40	40	4	
			32	56	8	16	0	
Absorbed by antigen 307	R	IV	56	52	52	56	28	
			40	44	16	20	0	
Absorbed by antigen 116	S	(4)	24	4	4	0	0	
			8	0	0			
Absorbed by antigen 209	S	III	16	12	0	0	0	
			12	8				
Absorbed by antigen 306	S	I	72	12	8	0	0	
			40	16	0			

The serum used in this test was from horse 823, immunized against two strains of group S.
The absorbed serum was tested against strain 55.
The absorbing antigens were of a turbidity of 3,900 parts per million.

[1] The upper figures refer to the percentage of phagocyting cells.
[2] The lower figures refer to the percentage of filled cells.
[3] The serum was absorbed by antigen 55, which was a typical strain belonging to group S and Type II, in order that the absorbing power of the other strains may be compared with it.
[4] Indefinite.

TABLE XV.—*The tropin absorption reactions of group Z strains.*

Strain.	Absorption from serum of groups.				Absorption from group Z serum.	
	R	S	T	U	60	138
60	Partial	Partial	Partial	Partial	Complete	Partial.
138	None	Partial	None	Partial	Partial	Complete.
298	Partial	Partial	Partial		None	Complete.
304	Partial	Partial	None		None	Complete.

TABLE XVI.—*Reactions of strain 135 with commercial serum before and after 30 mouse passages.*

	Locke's solution.	Normal rabbit serum.		Immune serum.			
		1–50	1–100	1–50	1–100	1–300	1–500
Old stock strain:							
Percentage of phagocyting cells	0	0	0	12	16	8	0
Percentage of filled cells				12	4	0	
After passage through mice:							
Percentage of phagocyting cells	4	8	0	76	76	24	0
Percentage of filled cells	0	0		40	60	8	

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TABLE XVII.—*Tropinogenic power of strain 135.*

Days since first inoculation.	Antigen used for tropin reaction.	Locke's solution.	Normal rabbit serum 1–50.	Serum of rabbit 45.[1]		Serum of rabbit 41.[2]		
				1–50	1–100	1–50	1–100	1–300
22	Old stock	0	[3] 4	12	8	8	0	.....
		.....	[4] 0	0	0	0	.....	.....
	Passage	0	0	4	0	64	16	8
		.....	.....	0	.....	20	8	0
28	Old stock	8	8	4	4	0	12	.....
		0	0	0	0	.....	0	.....
	Passage	0	4	4	0	60	60	60
		.....	0	0	.....	24	12	0
38	Old stock	.....	.....	20	4	.....	.....	.....
		.....	.....	0	0	.....	.....	.....
	passage	.....	.....	8	0	.....	.....	.....
		.....	.....	0	.....	.....	.....	.....

[1] Rabbit 45 was inoculated with the old-stock strain.
[2] Rabbit 41 was inoculated with the strain after passage.
[3] The upper figures refer to the percentage of phagocyting cells.
[4] The lower figures refer to the percentage of filled cells.

TABLE XVIII.—*Development of tropins in horses inoculated for experimental purposes.*

Days.	Tropins in serum 817.[1]			Tropins in serum 823.[2]			Tropins in serum 827.[3]		
	Group R.	Group S.	Group T.	Group R.	Group S.	Group T.	Group R.	Group S.	Group T.
0	[4] 0	0	.....	0	0	.....	0	0	.....
89	0	[5] 1–100	.....	0	1–100	.....	0	0	.....
109	0	0	.....	0	1–500	.....	0	1–300	.....
128	1–50	0	.....	0	1–800	.....	0	1–800	.....
145	0	0	.....	0	1–800	.....	0	1–500	.....
161	0	0	.....	0	1–1,200	.....	0	1–500	.....
186	1–50	0	0	0	1–500	.....	0	1–800	.....
198	1–50	0	0	.....	1–800	0	0	1–500	0
216	1–50	0	0	0	1–500	.....	0	1–500	0
234	1–100	1–100	0	.....	1–500	0	1–50	1–500	.....
254	1–100	1–100	.....	0	1–800	.....	1–50	1–800	0
270	1–50	1–50	0	0	1–500	0	1–50	1–1,200	0
288	1–50	1–50	0	0	1–500	0	0	1–1,200	0
308	0	0	.....	0	1–500	.....	.....	.....	.....

[1] Horse 817 was inoculated with strain 135 (group T).
[2] Horse 823 was inoculated with strain 136 (group S).
[3] Horse 827 was inoculated with strains 135 and 136.
[4] Zero indicates no reaction in the lowest dilution of 1–50.
[5] The recorded dilutions indicate the highest dilution showing a positive reaction.

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TABLE XIX.—*The temperature at which tropins and agglutinins are destroyed.*

	Locke's solution.	Tropin reactions in dilutions of—						Agglutinin reactions in dilutions of—					
		1–50	1–100	1–300	1–500	1–800	1–1,200	1–50	1–100	1–300	1–500	1–800	1–1,200
Negative control...	[1] 4	12	20	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Normal horse serum.....	[2] 0	0	0	.....	.....	.....	.....	[2] 0	0	.....	.....	.....	.....
Positive control...	.....	.....	.....	.....	60	48	28	.....	.....	.....	.....	.....	.....
Serum not heated..	.....	.....	.....	.....	20	8	4	4	4	4	3	3	3
Heated to 55° C....	.....	.....	.....	.....	64	56	44	.....	.....	.....	.....	.....	.....
	.....	.....	.....	.....	36	12	8	3	3	3	3	3	3
Heated to 60° C....	.....	.....	84	80	44	36	20	.....	.....	.....	.....	.....	.....
	.....	.....	36	44	12	8	0	0	0	0	0	0	0
Heated to 65° C...	.....	12	8	16	68	12	12	.....	.....	.....	.....	.....	.....
	.....	0	0	0	16	4	0	0	0	0	3	3	4

A repetition of the above test is given below.

Negative control...	0	4	0	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Normal horse serum.....	.....	0	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Positive control...	.....	.....	56	48	32	4	4	0	0	.....	.....	.....	.....
Serum not heated..	.....	.....	48	12	8	0	0	4	4	4	4	3	1
Heated to 55° C....	.....	.....	44	44	36	0	0	.....	.....	.....	.....	.....	.....
	.....	.....	24	24	4	.....	.....	4	4	4	4	3	1
Heated to 60° C....	.....	.....	72	52	20	0	0	.....	.....	.....	.....	.....	.....
	.....	.....	28	12	0	.....	.....	0	0	0	0	0	0
Heated to 65° C....	.....	.....	20	40	8	0	.....	.....	.....	.....	.....	.....	.....
	.....	.....	0	12	0	0	.....	0	0	3	4	4	3

[1] The upper figures refer to the percentage of phagocyting cells.
[2] The lower figures refer to the percentage of filled cells.
[3] Degree of agglutination is expressed in terms of 0 to 4, 4 representing complete agglutination with a clear supernatant fluid. Degrees of agglutination represented by 3 and 4 would be interpreted as a positive reaction.

TABLE XX.—*Comparison of results obtained for the tropin content of a commercial serum used for a positive control in 10 consecutive tests.*

Date.	Group R tropins in dilutions—			Group S tropins in dilutions—		
	1–50	1–100	1–300	1–50	1–100	1–300
1919.						
Jan. 14	[1] 52	44	16	.....	64	40
	[2] 28	20	0	.....	44	12
Jan. 16	.....	56	0	.....	52	32
	.....	36	.....	.....	20	4
Jan. 18	.....	56	0	.....	76	20
	.....	4	.....	.....	40	0
Jan. 20	.....	60	4	.....	48	8
	.....	20	0	.....	24	0
Jan. 23	.....	64	44	.....	80	32
	.....	28	4	.....	20	4
Jan. 25	.....	68	24	.....	80	24
	.....	28	8	.....	32	8
Mar. 6	.....	56	20	.....	56	40
	.....	28	0	.....	36	12
Mar. 8[3]	8	16	4	.....	64	8
	0	4	0	.....	60	0
Mar. 11	.....	52	12	.....	64	8
	.....	44	0	.....	60	0
Mar. 13	.....	52	4	.....	64	24
	.....	20	0	.....	36	0

[1] The upper figures refer to the percentage of phagocyting cells.
[2] The lower figures refer to the percentage of filled cells.
[3] The negative reaction of the positive control showed that there was something wrong for that day's test. The data for all serums tested had to be discarded and the test repeated.

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CHART 1 :- RELATIONSHIP BETWEEN THE AGGLUTININ TYPES AND THE TROPIN GROUPS.

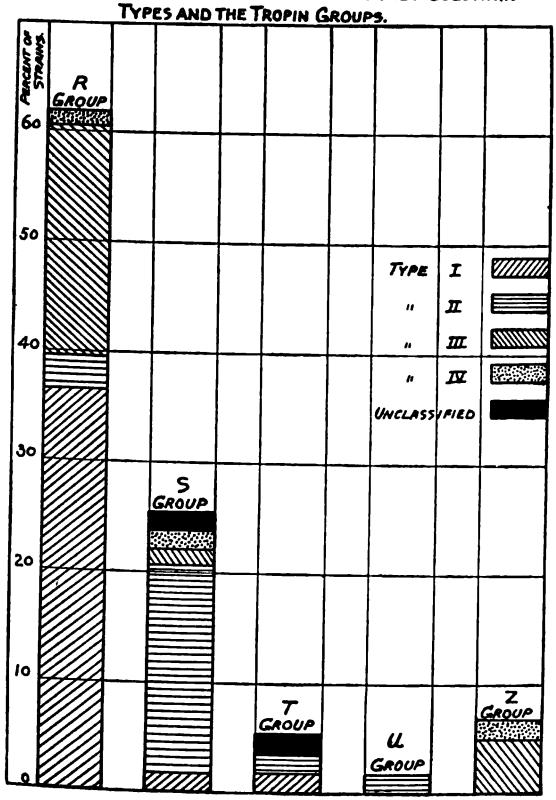

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CHART 2:- DEVELOPMENT OF THE AGGLUTININS AND TROPINS IN THE SERUM OF IMMUNIZED RABBITS.

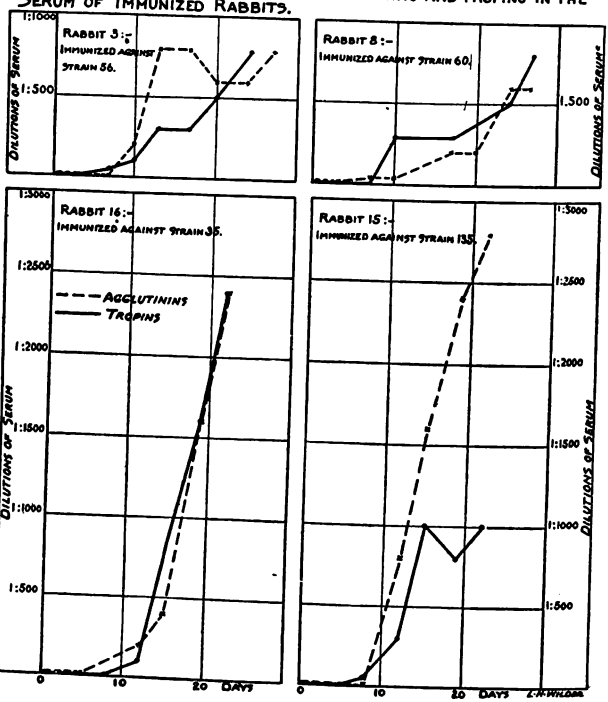

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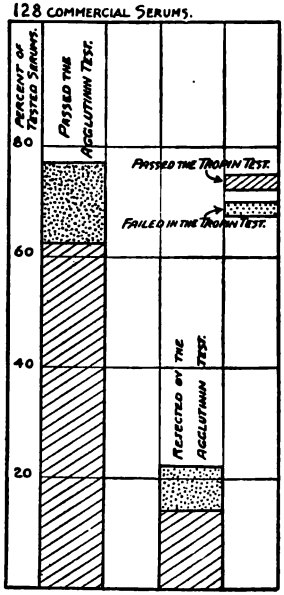
CHART 3 :— RELATIONSHIP BETWEEN THE TROPINS AND AGGLUTININS IN 128 COMMERCIAL SERUMS.



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III. EFFECT OF FREEZING AND THAWING UPON THE ANTIBODY CONTENT OF ANTIMENINGOCOCCUS SERUM.[1]

By C. T. BUTTERFIELD, Sanitary Bacteriologist, United States Public Health Service.

It appears likely that an improvement in antimeningococcus serum to be used for diagnostic purposes might be brought about by freezing and thawing it. This throws down the fibrin, which, if not removed, sometimes causes nonspecific reactions in agglutination tests.

In the freezing and thawing experiments described, two procedures were followed. In the first case antimeningococcus serums 56–B, 57–A, 123–D, and 305 (numbered according to the numbers of the Hygienic Laboratory strains with which they were prepared) were frozen and thawed by what is called the "slow thaw" process. In this, the serums were frozen by keeping them in a freezing mixture at −10° C. until they were entirely solidified; they were then placed immediately in the cold box (+5°C.) and allowed to thaw slowly. About 4 to 5 hours were required to complete this thawing process, which was repeated daily until the serums had been treated and tested as indicated in the appended table.

In the second procedure serums 11–D, 57–C, 60–H, and 123–D were frozen in the same manner as in the first. The frozen serums were then thawed out ("rapid thaw") by immersing the container in the 56° C. water bath and shaking until the serum was completely liquid. The melting required from 1 to 2 minutes. This process was repeated in rapid succession in the case of these four specimens until the serums had been frozen and thawed 12 times. About 5 or 6 minutes were required to complete one cycle of this process. Serum 123–D used in this series was the same serum which had been previously frozen and thawed 15 times by the slow process. This made 27 exposures for this serum.

With all serums except 11–D and 57–C, using both procedures a flocculent precipitate was formed. This divided itself, upon centrifuging the serum, into two fractions, one lighter than the serum and the other heavier. In all cases the serum was centrifuged and a clear specimen obtained before making the final test.

In the case of serum 57–A and serum 305, portions were treated by the first process both with and without the addition of the preservative (0.25 per cent phenol). Judging from the agglutination reaction

[1] Submitted for publication Feb. 7, 1920.

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the presence of the preservative in the serum during the freezing and thawing process has no effect upon the agglutinin content.

From these results it is evident that neither the freeze and slow thaw nor the freeze and rapid thaw nor a combination of the two (in the case of serum 123–D) has any effect upon the agglutinin content of the serums tried.

These same serums were tested for complement fixation bodies by Mr. H. B. Corbitt and for tropin bodies by Miss A. C. Evans. These workers found, with their respective tests, that each serum maintained the same titer for its homologous coccus, after either of the freeze and thaw processes, which it had before the processes had been applied.

During the process by the slow thaw method (in which the serum was agitated very little if at all) it was observed that there was an apparent stratification of the serum into two rather distinct layers; the first a more aqueous clear portion at the top and the second a heavier straw-colored portion at the bottom. Thinking that this might represent a concentration of the antibodies, portions of the serum from each layer were tested in each case. There was a slight difference; the lower, heavier, more highly colored portion containing the more antibodies. However, the concentration obtained was too slight to be of any practical value.

Judging from the results obtained in these experiments it is safe to assume that, within the limitations of this experiment:

1. Freezing and thawing of serum by the slow method has no effect upon its antibody content.

2. The same is true for the freeze and thaw by the rapid method and in the case of serum 123–D for a combination of both methods.

3. When a serum is frozen and thawed slowly without agitation, there is a very slight concentration of agglutinins in the lower levels.

4. The presence of 0.25 per cent phenol in a serum does not cause the freezing and thawing process to affect the antibody content of the serum.

Effect of freezing and thawing upon the antibody content of certain antimeningococci sera.

No. of serum.	Initial agglutination titer.	Times frozen and thawed, slow method.	Titer after this process.	Times frozen and thawed, rapid process.	Titer after this process.	Effect upon complement-fixation bodies and tropins.
56–B	800	15	800	.....	.....	None.
57–A	800	20	800	.....	.....	Do.
123–D	800	15	800	12	800	Do.
305	6,400	8	6,400	.....	.....	Do.
11–D	400	.....	.....	12	400	Do.
57–C	400	.....	.....	12	400	Do.
60–H	400	.....	.....	12	400	Do.

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IV.—THE FERMENTATION REACTIONS AND PIGMENT PRODUCTION OF CERTAIN MENINGOCOCCI.[1]

By CLARA E. TAFT, Sanitary Bacteriologist, United States Public Health Service.

All of the Hygienic Laboratory stock cultures were cultivated for fermentation reactions in serum sugar broths, and the hydrogen ion concentration read by the colorimetric method. One per cent of dextrose, saccharose and maltose sugars were used in five per cent serum broth. A tube of each of the three sugar broths was inoculated with a loopful of culture, and the tubes read on the fourth day after planting. It had been found by a preliminary test that cultures did not obtain their highest degree of acidity until this time. The readings were made with the standard solutions and indicators described by Clark and Lubs (1916) in their work on hydrogen ion concentration.

It is seen that all of the cultures produce acid in dextrose and maltose serum broth. All of them, except Nos. 60, 64, 98, 290, and 303, have no appreciable effect on saccharose broth or produce alkali in it. It is thus demonstrated that in a broth which contains a nonfermentable sugar certain changes take place which reduce the hydrogen ion concentration. Cultures 60, 64, and 98 show themselves atypical by the production of a considerable amount of acid in saccharose broth. Cultures 290 and 303 produce a small amount.

[1] Submitted for publication Feb. 7, 1920.

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Effect on the hydrogen ion concentration of sugar broths by meningococci.

Culture.	Dextrose serum broth.	Saccharose serum broth.	Maltose serum broth.	Culture.	Dextrose serum broth.	Saccharose serum broth.	Maltose serum broth.
6	6.5	7.5	6.4	154	6.3	7.8	6.0
10	6.8	7.4	6.5	203	6.4	7.8	6.6
11	6.6	7.3	6.5	205	6.8	7.5	6.4
12	6.6	7.5	6.6	207	6.4	7.5	6.6
50	6.0	7.7	6.0	209	6.0	7.6	6.0
55	6.4	7.5	6.0	265	6.2	7.6	6.0
88	6.6	7.6	6.2	273	6.4	7.4	6.4
58a	6.0	7.7	6.6	274	6.4	7.8	6.4
57	6.4	7.6	6.4	280	6.0	7.5	6.2
58	6.7	7.4	6.7	281	6.7	7.8	6.4
59	6.5	7.6	6.5	282	6.0	7.4	6.0
60	6.6	6.5	6.4	283	6.4	8.0	6.7
64	6.0	6.8	5.9	284	6.2	7.6	6.0
93	6.5	7.6	6.0	286	6.5	7.6	6.0
98	6.4	6.6	6.4	287	6.0	8.2	6.3
104	6.0	7.8	6.0	289	6.0	7.8	6.0
106	6.2	7.9	6.0	290	6.6	7.1	7.2
110	6.4	7.5	6.3	291	6.3	7.5	6.4
114	6.6	7.6	6.4	292	6.6	7.5	6.7
116	6.6	7.4	6.5	293	6.4	7.4	6.0
119	6.5	7.3	6.5	294	6.4	7.9	6.6
120	6.0	7.8	6.0	295	6.0	7.5	5.6
123	6.4	7.5	6.0	296	6.6	7.5	6.5
124	6.0	7.4	6.0	298	6.4	7.5	6.0
126	6.2	7.8	6.2	300	6.0	7.9	6.0
128	6.4	7.9	6.0	301	6.2	7.6	6.5
134	6.6	7.5	6.4	302	6.2	7.6	6.2
135	6.6	7.8	6.5	303	6.2	7.2	6.0
136	6.2	7.6	6.4	304	6.0	7.8	6.3
138	6.6	7.4	6.6	306	6.4	7.5	6.4
140	6.0	8.4	6.0	307	6.2	8.0	6.0
153	6.4	7.6	6.0	308	6.2	7.8	6.6

PIGMENT PRODUCTION.

Sixty-four of the Hygienic Laboratory stock strains of meningococci were tested for pigment production by the color charts of Ridgway's Color Standards and Nomenclature (1912). The tests were made by placing about two loopfuls of growth on a small piece of heavy white drawing paper, spreading it thickly and evenly over a space of about ½ centimeter in diameter. It was then matched with the nearest colors in the charts.

Forty-nine of the 64 cultures fell with tint "d" of the 19″ YO–Y series of Plate XXX, called cream buff. It is a light tint of a hue formed from 53 per cent of yellow and 47 per cent of orange, dulled by 58 per cent admixture of neutral gray.

Sixteen of the cultures matched with tint "f" of the 19″ YO–Y series, a lighter tone, called cream color. It is composed of the same amounts of yellow and orange, but is dulled by only 32 per cent of neutral gray.

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All of the cultures were one week old when tested, except two 8-day cultures and one 11-day culture. The reference to Ridgway's chart for each culture is as follows:

6	19″ YO–Y (d)	209	19″ YO–Y (d)
10	19″ YO–Y (d)	265	19″ YO–Y (d)
11	19″ YO–Y (d)	273	19″ YO–Y (d)
12	19″ YO–Y (d)	281	19″ YO–Y (d)
50	19″ YO–Y (d)	283	19″ YO–Y (d)
55	19″ YO–Y (d)	286	19″ YO–Y (d)
56	19″ YO–Y (d)	287	19″ YO–Y (d)
56a	19″ YO–Y (d)	289	19″ YO–Y (d)
57	19″ YO–Y (d)	290	19″ YO–Y (d)
58	19″ YO–Y (d)	292	19″ YO–Y (d)
59	19″ YO–Y (d)	294	19″ YO–Y (d)
60	19″ YO–Y (d)	296	19″ YO–Y (d)
93	19″ YO–Y (d)	298	19″ YO–Y (d)
98	19″ YO–Y (d)	300	19″ YO–Y (d)
104	19″ YO–Y (d)	306	19″ YO–Y (d)
106	19″ YO–Y (d)		
110	19″ YO–Y (d)	64	19′ YO–Y (f)
114	19″ YO–Y (d)	119	19′ YO–Y (f)
116	19″ YO–Y (d)	135	19′ YO–Y (f)
120	19″ YO–Y (d)	274	19′ YO–Y (f)
123	19″ YO–Y (d)	280	19′ YO–Y (f)
124	19″ YO–Y (d)	282	19′ YO–Y (f)
126	19″ YO–Y (d)	284	19′ YO–Y (f)
128	19″ YO–Y (d)	291	19′ YO–Y (f)
134	19″ YO–Y (d)	293	19′ YO–Y (f)
136	19″ YO–Y (d)	295	19′ YO–Y (f)
138	19″ YO–Y (d)	301	19′ YO–Y (f)
140	19″ YO–Y (d)	302	19′ YO–Y (f)
153	19″ YO–Y (d)	303	19′ YO–Y (f)
154	19″ YO–Y (d)	304	19′ YO–Y (f)
203	19″ YO–Y (d)	307	19′ YO–Y (f)
205	19″ YO–Y (d)	308	19′ YO–Y (f)
207	19″ YO–Y (d)		

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V. STUDIES ON THE LETHAL ACTION OF SOME MENINGOCOCCI ON MICE, WITH SPECIAL REFERENCE TO THE PROTECTIVE PROPERTIES OF ANTI MENINGOCOCCUS SERUM.[1]

By M. H. NEILL, Passed Assistant Surgeon, United States Public Health Service, and CLARA E. TAFT, Sanitary Bacteriologist, United States Public Health Service.

INTRODUCTION.

In considering the several methods available for testing the potency of antibacterial serums, the animal-protection test possesses certain theoretical advantages which challenge our attention. In the first place, the reactions we are interested in take place in the living body of the animal rather than in the artificial environment of the test tube, as in the complement fixation, tropin, and agglutination tests; secondly, the serum is tested in toto, all its constituents acting together and not separately as in the test-tube tests; in the third place, the end point is definite, i. e., the death or survival of the injected animal, and not questionable as frequently occurs in in vitro tests even under the best conditions.

In contrast with these advantages stands the fact of the enormous variability of the smaller animals in their resistance to biological poisons. It must be said that the practice of making protection tests, using only one or two animals to a given dose of poison and antiserum is liable to gross inaccuracy and may far outweigh any advantages of the animal test due to its easily determined end point.

Furthermore, it must be admitted that the animal-protection test does not of necessity take precedence over all other tests as being an exact counterpart of what occurs when serums are used therapeutically in human disease; thus, it is illogical to assume that what takes place in the peritoneal cavity of a mouse when antigen and serum are mixed is an exact indication of the action of, for example, antimeningococcus serum in the cerebrospinal canal of man. The anatomical conditions are too widely dissimilar to warrant the prediction of identical results.

With these introductory remarks we desire to present the following data. A review of the literature convinced us of the necessity of a thorough study of the antigens for use in the tests before attempting the tests themselves.

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PROTECTION TESTS WITH LIVE CULTURE.

Hitchens and Robinson (1916) and Amoss and Marsh (1918) have recently presented some data with reference to the protection test. In general, while it was found that antimeningococcus serum would protect mice against living cultures of the meningococcus, the results were at times irregular and inconsistent and the test was not placed on a sound quantitative basis. In working with live cultures we soon became convinced of their low virulence and planned the following experiments in the hope of securing more virulent cultures and thus overcoming some of the shortcomings of the mouse-protection test which had been observed by other workers as well as by ourselves. To this end a program for passing the cultures through mice was initiated.

ATTEMPTS TO RAISE VIRULENCE BY ANIMAL PASSAGE.

The meningococcus has been found by most investigators to be an organism of very weak and variable virulence for the laboratory animals. Not all cultures are even moderately pathogenic for mice and guinea pigs, although it is always possible to cause the death of these animals by the injection of a large amount of culture.

In looking through the literature on the subject of virulence of the meningococci, we have found few workers who have carried the cultures through animals for any length of time in order to raise the virulence. Lepierre (1903) was the only one who claims to have obtained really positive results. By inoculating rabbits subcutaneously or intravenously with a large dose of culture (10 to 20 c. c. of ascitic bouillon per kilogram of rabbit weight), he found that cultures of the fourth or fifth passage killed at the end of some hours or days and that heart-blood cultures could be recovered. By gradually decreasing the intravenous dose and incubating the heart-blood cultures for 48 hours in ascitic bouillon, he claims to have succeeded after eight or nine passages in obtaining a culture which would kill a rabbit in 12 to 30 hours in a dose of 0.01 to 0.02 c. c. This virulence, he states, may be held for more than a month by growing the culture in ascitic media followed by a single rabbit passage. Lepierre found mice and guinea pigs also sensitive, but less so than the rabbits. Increase in the virulence of the cultures was also obtained by successive intraperitoneal inoculation and by the use of sacs of collodion placed within the peritoneal cavity.

Leuchs and Lingelsheim (1905–6) found that guinea pigs were more susceptible to the organism than mice. They used doses several times as large as the fatal dose in an attempt to weaken the bactericidal power of the animal body. Ten strains were passed through successive animals by making heart-blood cultures, with the result that

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after the third or fourth passage the virulence fell. In order that cultures might be fatal at the termination of the experiment, they had to be used in several times the former fatal dose. One strain was carried to the tenth passage before the virulence weakened. These workers encountered difficulty through secondary infection in the blood cultures.

In order to ascertain whether differences in media affected the virulence of a culture, several strains of known virulence were grown on special media and then tried on animals. Different kinds of acid media were used, as acid brain agar, milk acid ascitic agar, milk acid grape-sugar ascitic agar, and in addition mucous bouillon and potato. A slight rise in virulence was seen sometimes in the milk acid ascitic agar cultures, but the differences were not distinct enough to warrant conclusions being drawn.

Wassermann and Kolle (1906), in trying to test antimeningococcus serum by protection tests with guinea pigs, attempted to raise the virulence of the cultures by mouse passage. No increase in virulence was obtained, and only when freshly isolated virulent cultures were obtainable could the specific protective action of the serum be demonstrated.

Recently Gordon (1918) has attempted to extract the endotoxin from meningococcus cultures by drying the cultures, grinding them in a mortar with sterile sand, adding distilled water, and centrifuging, as will be referred to subsequently. In connection with this work he tried mouse passage of cultures in the hope of increasing the endotoxin. A number of cultures were passed without increasing the virulence. Passage through five mice of a culture obtained from a fulminating case of meningitis, however, raised the virulence of the living coccus (Type I) tenfold, but no increase in the amount of endotoxin could be detected when the organisms were dried and the aqueous extract used.

Flexner (1907), in his work on the meningococcus, has found that freshly isolated cultures are usually much more virulent than cultures grown on artificial media for a period. He has found an occasional strain which will retain its virulence for many months, but when the virulence is lost it can not be restored by passage through mice or guinea pigs.

We selected six cultures for mouse passage, strains Nos. 56, 98, 135, 136, 300, and 301 of the Hygienic Laboratory stock cultures. For further information regarding the cultures, see accompanying paper by Butterfield and Neil. By agglutination reactions strains Nos. 98 [1] and 135 had been typed as belonging to Type I, strains Nos. 136, 56, 300, and 301 to Type II. Strains Nos. 300 and 301 had been recently isolated when work was commenced upon them.

[1] No. 98 has affinities for both Type I and Type III.

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An attempt was made in the early part of the work to standardize the doses by comparing them with a turbidity standard of finely divided silica in suspension, and to use the minimum lethal dose, diminishing it if any increase in virulence were shown. It was soon found, however, that by this method passages could not be secured in rapid succession, as colonies of meningococci often failed to appear in a heart blood culture if the dose were small, or would often be badly contaminated if the mouse lived for more than 24 hours or remained in the cold room over night after death. The following method of procedure providing for rapid and frequent passages was therefore adopted: An unstandardized dose, consisting of 2 c. c. of a heavy suspension of meningococci (the suspension being usually secured by adding 5 c. c. of Locke's solution to a heavy rabbit blood-agar-plate growth), was injected in a mouse in the morning, and the mouse was usually killed in the afternoon four to five hours later. At first four, later two, mice were used at each injection for each culture, but, as the culture was almost invariably recovered from both mice, one was found to be sufficient. The mice were etherized until dead or entirely unconscious, and heart blood cultures were made on rabbit blood agar plates by removing the blood from the heart with a capillary pipette. These plates were incubated over night and were examined the next morning for purity. If they were found pure the heavy growth was washed off with Locke's solution and directly injected into more mice, but if found contaminated, colonies of meningococci were fished and planted on glucose serum agar slants (1 per cent glucose, 5 per cent horse serum). If the tube cultures were used, 5 c. c. of Locke's solution were used to one slant of heavy growth and 2 c. c. of this suspension injected. Two plates were made from each mouse at autopsy, the entire amount of blood being smeared on one plate by means of a bent capillary pipette, the same pipette being used on the second plate. A heavy growth could thus be obtained on one plate and a thin growth with segregated colonies which could be fished on the other. Fishings were made from plates to glucose serum agar slants for each culture at every passage in order to have a culture of recent passage to use if the culture should be lost by injection.

The following numbers of passages were run on the six cultures used:

Number of culture.	Number of passages.
98	61
135	66
56	60
136	57
300	41
301	45

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Cultures Nos. 56, 98, and 135 were run for four months, culture No. 136 for three months, and cultures Nos. 300 and 301 for two and a half months. The following tables show the number of passages made for each culture, the doses given with the dates of injection, the time the culture remained in the mouse after each injection, and whether the culture used was a plate or fished culture. When the culture used was a slant growth, it is indicated in the tables when it was fished. Otherwise inoculation directly from a heart blood plate is indicated. The slant cultures were fished from 19 to 24 hours before injection, and the plates, being usually made from 3.30 to 4.30 o'clock in the afternoon and injected from 10 to 11 o'clock in the morning, had, as a rule, 17½ to 19½ hour growths. Only the mouse from which the culture was taken is indicated in the tables, although more mice were used in the early part of the work. When several days intervene between injections it is because the culture was lost in passage and it was necessary to return to an old fished culture.

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PROTOCOL No. 1.—*Successive passages of cultures of meningococci through mice.*

Date	Culture 98				Culture 135			
	No. of Passage	Source and Amount of Dose	Time between Intraperitoneal Injection and Heart's Blood Culture	History of Cultures to Time of Next Injection	No. of Passage	Source and Amount of Dose	Time between Intraperitoneal Injection and Heart's Blood Culture	History of Culture to Time of Next Injection
2/17						1 c. c. of Stock Cultures		
2/18							Killed after 21 hrs. Plated	
2/19								Fished
2/20								On slant
2/21								" "
2/22								" "
2/23								" "
2/24								" "
2/25	1	1 c. c. of Stock Culture						
2/26			Killed after 20½ hrs. Plated		2	2 c. c. of Culture Fished 2/19		
2/27				Fished			Killed after 20 hrs. Plated	
2/28				On slant	3	1 c. c. of 2/26 Plate		
3/1	2	2 c. c. of Culture Fished 2/27	" " 4 " "				Killed after 23 hrs. Plated	
3/2								Fished
3/3				On plate				On slant
3/4				Fished				" "
3/5				On slant				" "
3/6	3	" " " " 3/3	" " 4 " "	" "	4	2 c. c. of Culture Fished 3/1	Killed after 4½ hrs. Plated	
3/7	4	" " 3/6 Plate	" " " " "		5	2 c. c. of 3/6 Plate	" " 4 " "	
3/8	5	" " 3/7 "	" " " " "					
3/9					6	" " Culture Fished 3/7	" " 5 " "	Fished
3/10	6	" " Culture Fished 3/9	" " " " "	Fished				
3/11	7	" " 3/10 Plate	" " " " "		7	" " " " 3/9	" " 4 " "	"
3/12	8	" " 3/11 "	" " 4½ " "		8	" " 3/10 Plate	" " 4½ " "	
3/13	9	" " 3/12 "	" " 4 " "					
3/14					9	" " Culture Fished 3/12	" " 4 " "	Fished
3/15	10	" " Culture Fished 3/14	" " " " "	Fished	10	" " 3/13 Plate	" " " " "	
3/16					11	" " 3/14 "	" " " " "	
3/17	11	" " " " 3/16	" " 3 " "	Fished				
3/18	12	" " 3/17 Plate	" " 4 " "		12	" " Culture Fished 3/16	" " 3 " "	Fished
3/19					13	" " 3/17 Plate	" " 4 " "	
3/20	13	" " Culture Fished 3/19	" " " " "	Fished	14	" " 3/18 "	" " " " "	
3/21	14	" " 3/20 Plate	" " 3½ " "		15	" " 3/19 "	" " " " "	
3/22				"				
3/23								Fished
3/24	15	2 c. c. of Culture Fished 3/22	Killed after 4 hrs. Plated	On slant				On slant
3/25	16	" " 3/24 Plate	" " " " "		16	2 c. c. of Culture Fished 3/21	Killed after 4 hrs. Plated	On slant
3/26	17	" " 3/25 "	" " " " "		17	" " 3/24 Plate	" " " " "	
3/27	18	" " 3/26 "	" " 4½ " "					Fished
								On slant

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3/28	19	" " 3/27 "	" " 4 " "	
3/29	20	" " 3/28 "	" " " " "	
3/30				
3/31	21	" " Culture Fished 3/30	" " 4½ " "	Fished
4/1	22	" " 3/31 Plate	" " " " "	
4/2	23	" " 4/1 "	" " 4 " "	
4/3	24	" " 4/2 "	" " " " "	
4/4	25	" " 4/3 "	" " " " "	
4/5				
4/6				Fished
4/7	26	" " Culture Fished 4/5	" " " " "	On slant
4/8	27	" " 4/7 Plate	" " " " "	
4/9				
4/10	28	" " Culture Fished 4/9	" " " " "	Fished
4/11	29	" " 4/10 Plate	" " 3½ " "	
4/12	30	" " 4/11 "	" " 4 " "	
4/13				
4/14	31	" " Culture Fished 4/13	" " 4 " "	Fished
4/15	32	" " 4/14 Plate	" " " " "	
4/16				
4/17				Fished
4/18				On slant
4/19				" "
4/20				" "
4/21	33	2 c. c. of Culture Fished 4/16	Killed after 4 hrs.	Plated
4/22	34	" " 4/21 Plate	" " 4½ "	"
4/23	35	" " 4/22 "	" " 4 "	"
4/24				
4/25	36	" " Culture Fished 4/24	" " 4½ "	"
4/26	37	" " 4/25 Plate	" " " "	"
4/27				Fished
4/28	38	2c. c. of Culture Fished 4/27	Killed after 4½ hrs.	Plated
4/29	39	" " 4/28 Plate	" " " "	"
4/30	40	" " 4/29 "	" " " "	"
5/1				
5/2	41	" " Culture Fished 5/1	" " " "	Fished
5/3				"
5/4				On slant
5/5	42	" " " " 5/3	" " " "	
5/6				Fished
5/7				On slant
5/8				Plate
5/9				Fished
5/10	43	" " Culture Fished 5/9	" " " "	
5/11				On plate
5/12				Fished
5/13	44	" " " " 5/12	Dead " 5 "	"
5/14				On slant
5/15	45	" " " " 5/14	Killed " " "	
5/16				
5/17	46	" " " " 5/16	" " 4½ "	"
5/18				On plate

18	"	" Culture Fished 3/26	" " " "	
19	"	" 3/28 Plate	" " " "	
20	"	" Culture Fished 3/30	" " 4½ "	Fished
21	"	" 3/31 Plate	" " " "	
22	"	" 4/1 "	" " 4 "	
23	"	" 4/2 "	" " " "	
24	"	" 4/3 "	" " " "	
25	"	" 4/4 "	" " " "	
26	"	" Culture Fished 4/6	" " " "	Fished
27	"	" 4/7 Plate	" " " "	
28	"	" Culture Fished 4/9	" " " "	Fished
29	"	" 4/10 Plate	" " 3½ "	
				Fished
30	"	" Culture Fished 4/12	" " 4 "	On slant
31	"	" 4/14 Plate	" " " "	
32	"	" Culture Fished 4/16	" " " "	Fished
33	"	" 4/17 Plate	" " " "	
34	"	" 4/18 "	" " " "	
35	"	" Culture Fished 4/20	" " " "	Fished
36	"	" 4/21 Plate	" " 4½ "	
37	"	" 4/22 "	" " 4 "	
38	"	" 4/23 "	" " 4½ "	
39	"	" 4/24 "	" " " "	
40	"	" 4/25 "	" " " "	
41	2 c. c. of Culture Fished 4/27		Killed after 4½ hrs.	Plated
42	"	" 4/28 Plate	" " " "	"
43	"	" 4/29 "	" " " "	"
44	"	" Culture Fished 5/1	" " " "	Fished
45	"	" 5/2 Plate.	" " " "	
				On plate
46	"	" Culture Fished 5/5	" " " "	Fished
47	1 c. c. "	" " 5/7	(Virulence Test)	Fished
				Plated
				Fished
48	2 c. c. "	" " 5/10	Killed after 4½ hrs.	On slant
49	"	" " " "		Fished
			Killed " 18 hrs.	"
50	"	" 5/15 Plate	Killed after 5 hrs.	Plated
51	"	" 5/16 "	" " 4½ "	"
				On plate

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PROTOCOL No. 1.—*Successive passages of cultures of meningococci through mice*—Continued.

Date	Culture 98—Continued				Culture 135—Continued			
	No. of Passage	Source and Amount of Dose	Time between Intraperitoneal Injection and Heart's Blood Culture	History of Cultures to Time of Next Injection	No. of Passage	Source and Amount of Dose	Time between Intraperitoneal Injection and Heart's Blood Culture	History of Culture to Time of Next Injection
5/19	47	2 c. c. of 5/17 Plate	Killed after 4½ hrs. Plated		52	2 c. c. of Culture Fished 5/19	Killed after 5 hrs. Plated	Fished
5/20	48	" " 5/19 "	" " 4½ " "	Fished	53	" " 5/20 Plate	" " 5 " "	Fished
5/21								
5/22	49	" " Culture Fished 5/21	Dead " " " "		54	" " Culture Fished 5/22	" " " " "	
5/23	50	" " 5/22 Plate	Killed " 5 " "	Fished	55	" " 5/23 Plate	" " " " "	On plate
5/24				On slant				Fished
5/25					56	" " Culture Fished 5/26	" " " " "	
5/26	51	" " Culture Fished 5/24	" " 4½ " "					Fished
5/27	52	" " 5/26 Plate	" " 5 " "	Fished	57	" " " " 5/28	" " 4½ " "	
5/28								On plate
5/29	53	" " Culture Fished 5/28	" " 4½ " "	On plate				Fished
5/30				Fished				On slant
5/31				On slant				
6/1					58	2 c. c. of Culture Fished 5/31	Killed after 4½ hrs. Plated	
6/2	54	2c. c. of Culture Fished 5/31	Killed after 4½ hrs. Plated		59	" " 6/2 Plate	" " " " "	
6/3	55	" " 6/2 Plate	" " " " "		60	" " 6/3 "	" " " " "	Fished
6/4	56	" " 6/3 "	" " " " "	Fished				
6/5					61	" " Culture Fished 6/5	" " " " "	
6/6	57	" " Culture Fished 6/5	" " " " "		62	" " 6/6 Plate	" " " " "	On plate
6/7	58	" " 6/6 Plate		On plate				Fished
6/8				Fished				On slant
6/9				On slant				" "
6/10								
6/11	59	" " Culture Fished 6/9	" " " " "	Fished	63	" " Culture Fished 6/9	" " 5 " "	
6/12					64	" " 6/12 Plate	" " " " "	Fished
6/13	60	" " " " 6/12	" " 5 " "	Fished				On slant
6/14				On slant				
6/15					65	" " Culture Fished 6/14	" " 4½ " "	Fished
6/16	61	" " " " 6/14	" " 4½ " "	Fished				On slant
6/17								" "
6/18								" "
6/19								" "
6/20								" "
					66	" " " " 6/17	" " " " "	Fished

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Date	Culture 56.				Culture 136			
	No. of Passage	Source and Amount of Dose	Time between Intraperitoneal Injection and Heart's Blood Culture	History of Culture to Time of Next Injection	No. of Passage	Source and Amount of Dose	Time between Intraperitoneal Injection and Heart's Blood Culture	History of Culture to Time of Next Injection
2/17	1	1 c. c. of Stock Culture	Killed after 1½ hrs. Plated					
2/18	2	2 c. c. of 2/17 Plate	" " 6 " "					
2/19	3	" " 2/18 "	" " 4 " "					
2/20	4	" " 2/19 "	" " 3 " "					
2/21								
2/22				Fished				
2/23				On slant				
2/24				" "				
2/25	5	1 c. c. of Culture Fished 2/21		" "				
2/26								
2/27	6	1 c. c. " 2/26 Plate	Killed after 19 hrs. Plated					
2/28								
3/1	7	2 c. c. of 2/28 Plate	Killed " 26 " "					
3/2			" " 3½ " "					
3/3	8	" " 3/1 "		On Plate				
3/4								
3/5			" " 20½ " "					
3/6	9	" " Culture Fished 3/5	" " 4 " "	Fished				
3/7	10	" " 3/6 Plate	" " 3½ " "					
3/8	11	" " 3/7 "	" " " " "					
3/9								
3/10	12	" " Culture Fished 3/9	" " 4 " "	Fished				
3/11	13	" " 3/10 Plate	" " " " "					
3/12								
3/13	14	" " Culture Fished 3/12	" " " " "	Fished				
3/14	15	" " 3/13 Plate	" " 3½ " "		1	2 c. c. of Stock Culture	Killed after 4 hrs. Plated	
3/15	16	" " 3/14 "	" " 4 " "		2	" " 3/13 Plate	" " " " "	
3/16								
3/17	17	" " Culture Fished 3/16	" " 3 " "	Fished	3	" " Culture Fished 3/15		Fished
3/18	18	" " 3/17 Plate	" " 4 " "					
3/19					4	" " 3/17 Plate	Dead after 24 hrs. Plated	
3/20	19	" " Culture Fished 3/19	" " " " "	"	5	" " 3/18 "	Killed after 4 hrs. Plated	
3/21							" " " " "	
3/22	20	" " " " 3/21	" " " " "	"	6	" " Culture Fished 3/20	" " 3½ " "	Fished
3/23					7	" " 3/21 Plate	Dead " 4 " "	
3/24				"				
3/25	21	2 c. c. of Culture Fished 3/23	Killed after 4 hrs. Plated	On slant	8	2 c. c. of Culture Fished 3/23	Killed after 4 hrs. Plated	Fished
3/26					9	" " 3/24 Plate	" " " " "	
3/27	22	" " " " 3/26	" " 4½ " "	Fished	10	" " 3/25 "	" " " " "	
3/28				"	11	" " 3/26 "	" " 4½ " "	
								Fished

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PROTOCOL No. 1.—*Successive passages of cultures of meningocci through mice*—Continued.

Date	Culture 56—Continued				Culture 136—Continued			
	No. of Passage	Source and Amount of Dose	Time between Intraperitoneal Injection and Heart's Blood Culture	History of Culture to Time of Next Injection	No. of Passage	Source and Amount of Dose	Time between Intraperitoneal Injection and Heart's Blood Culture	History of Culture to Time of Next Injection
3/29	23	2 c.c. of Culture Fished 3/28	Killed after 4 hrs. Plated		12	" " Culture Fished 3/28	Killed after 4 hrs. Fished.	
3/30				Fished.				Fished
3/31	24	" " " " 3/30	" " 4½ " "		13	" " Culture Fished 3/30	" " 4½ " "	
4/1	25	" " 3/31 Plate	" " 4½ " "		14	" " 3/31 Plate	" " " " "	
4/2	26	" " 4/1 "	" " 4 " "					Fished
4/3				Fished	15	" " Culture Fished 4/2	" " 4 hrs. Plated	
4/4				On slant	16	" " 4/3 Plate	" " " " "	
4/5				" "	17	" " 4/4 "	" " " " "	
4/6				" "				Fished
4/7				" "				On slant
4/8				" "	18	" " Culture Fished 4/6	" " " " "	
4/9								Fished
4/10	27	2 c. c. of Culture Fished 4/3	Killed after 4 hrs. Plated	" "	19	" " " " 4/9	" " " " "	
4/11	28	" " 4/10 Plate	" " 3½ " "		20	" " 4/10 Plate	" " 3½ " "	
4/12	29	" " 4/11 "	" " 4 " "					Fished
4/13				Fished				On slant
4/14	30	" " Culture Fished 4/13	Dead after 4 hrs. Plated		21	2 c. c. of Culture Fished 4/12	" " 4 " "	
4/15	31	" " 4/14 Plate	Killed after 4 hrs. Plated		22	" of 4/14 Plate	" " " " "	
4/16	32	" " 4/15 "			23	" " 4/15 "		
4/17			Killed after 19½ hrs. Plated				Dead after 19½ hrs. Plated	
4/18				Fished	24	" " 4/17 "	Killed after 4 hrs. Plated	
4/19	33	2 c. c. of Culture Fished 4/18	" " 4 hrs. Plated		25	" " 4/18 "	" " " " "	
4/20				Fished				Fished
4/21	34	" " " " 4/20	" " " " "		26	" " Culture Fished 4/20	" " 4 hrs. Plated	
4/22	35	" " 4/21 Plate	" " 4½ " "		27	" " 4/21 Plate	" " 4½ " "	
4/23				Fished	28	" " 4/22 "	" " 4 " "	
4/24	36	" " Culture Fished 4/23	" " " " "					Fished
4/25	37	" " 4/24 Plate	" " " " "		29	" " Culture Fished 4/24	" " 4½ " "	
4/26	38	" " 4/25 "	" " " " "		30	" " 4/25 Plate	" " " " "	
4/27				Fished				Fished
4/28	39	" " Culture Fished 4/27	" " " " "		31	" " Culture Fished 4/27	" " " " "	
4/29	40	2 c. c. of 4/28 Plate	Killed after 4½ hrs. Plated		32	2 c. c. of 4/28 Plate	Killed after 4½ hrs. Plated.	
4/30	41	" " 4/29 "	" " " " "		33	" " 4/29 "	" " " " "	
5/1				Fished.				Fished
5/2	42	" " Culture Fished 5/1	" " " " "		34	" " Culture Fished 5/1	" " " " "	
5/3	43	" " 5/2 Plate	" " " " "		35	" " 5/2 Plate	" " " " "	
5/4				On plate.				On plate

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5/5					Fished.
5/6					On slant.
5/7					" "
5/8	44	" " Culture Fished 5/5	" " 4 hrs	"	
5/9					Fished.
5/10	45	" " " " 5/9	" " 4½ "	"	
5/11					On plate.
5/12					Fished.
5/13	46	" " " " 5/12	" " 5 "	"	
5/14	47	" " 5/13 Plate			
5/15			Killed after 18 hrs.	Plated.	
5/16					Fished.
5/17	48	" " Culture Fished 5/16	" " 4½ hrs.	"	
5/18					On plate.
5/19	49	" " 5/17 Plate	" " 5 "	"	
5/20	50	" " 5/19 "	" " 4½ "	"	
5/21					Fished.
5/22	51	" " Culture Fished 5/21	" " " "	"	
5/23	52	" " 5/22 Plate	" " 5 "	"	
5/24					Fished.
5/25					On slant.
5/26					" "
5/27	53	" " Culture Fished 5/24	" " 5 hrs.	Plated.	
5/28	54	" " 5/27 Plate	" " " "	"	
5/29					Fished.
5/30					On slant.
5/31					" "
6/1					" "
6/2					" "
6/3					" "
6/4	55	2 c. c. of Culture Fished 5/29	Killed after 4½ hrs.	Plated.	
6/5					Fished.
6/6	56	" " " " 6/5	" " " "	"	
6/7	57	" " 6/6 Plate	" " " "	"	
6/8					On plate.
6/9					Fished.
6/10					On slant.
6/11	58	" " Culture Fished 6/9	" " " "	"	
6/12					Fished.
6/13	59	" " " " 6/12	" " 5 "	"	
6/14					Fished.
6/15					On slant.
6/16	60	" " " " 6/14	" " 4½ "	"	
6/17					Fished.
6/18					

36	" " Culture Fished 5/5	" " " "	"	Fished	
37	" " " " 5/7	" " 4 "	"	Fished	
38	" " 5/8 Plate	" " " "	"		
39	" " Culture Fished 5/10	" " 4½ "	"	Fished On slant	
40	" " " " 5/13			Fished	
		Killed after 18 hrs.	Plated.		
41	" " 5/15 Plate.	" " 5 hrs.	"		
42	" " 5/16 "	" " 4½ "	"		
43	" " Culture Fished 5/19	" " " "	"	On plate Fished	
44	" " 5/20 Plate.	" " 5 "	"		
45	" " 5/21 "	" " 4½ "	"		
46	" " 5/22 "	" " 5 "	"		
47	" " 8/23 "	" " " "	"		
48	" " Culture Fished 5/26	" " " "	"	On plate Fished	
49	" " " " 5/28	" " 4½ "	"	Fished	
50	" " " " 5/31	" " " "	"	On plate Fished On slant	
51	" " 6/2 Plate	" " " "	"		
52	2 c. c. of 6/3 Plate	Killed after 4½ hrs.	Plated.		
53	" " Culture Fished 6/5	" " " "	"	Fished	
54	" " " " 6/7	" " 5 "	"	Fished On slant	
55	" " " " 6/10	" " 4½ "	"	Fished	
56	" " " " 6/12	" " 5 "	"	"	
57	" " " " 6/14	" " 4½ "	"	" On slant	
				Fished On slant	

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PROTOCOL No. 1.—*Successive passages of cultures of meningococci through mice*—Continued.

Date	Culture 300				Culture 301			
	No. of Passage	Source and Amount of Dose	Time between Intraperitoneal Injection and Heart's Blood Culture	History of Culture to Time of Next Injection	No. of Passage	Source and Amount of Dose	Time between Intraperitoneal Injection and Heart's Blood Culture	History of Cultures to Time of Next Injection
4/3	1	2 c. c. of Stock Culture	Killed after 4 hrs. Plated		1	2 c. c. of Stock Culture	Killed after 4 hrs. Plated	
4/4	2	" " 4/3 Plate	" " " " "		2	" " 4/3 Plate	" " " " "	
4/5	3	" " 4/4 "	" " " " "		3	" " "		On plate
4/6				Fished				Fished
4/7	4	" " Culture Fished 4/6	" " " " "					On slant
4/8	5	" " 4/7 Plate	" " " " "					" "
4/9				Fished				
4/10	6	" " Culture Fished 4/9	" " " " "		4	" " Culture Fished 4/7	" " " " "	
4/11	7	" " 4/10 Plate	" " 3½ " "		5	" " 4/10 Plate	" " 4½ " "	
4/12	8	" " 4/11 "	" " 4 " "		6	" " 4/11 "	" " 4 " "	
4/13				Fished				Fished
4/14	9	" " Culture Fished 4/13	" " 4 " "		7	" " Culture Fished 4/13	" " " " "	
4/15	10	" " 4/14 Plate	" " " " "		8	" " 4/14 Plate	" " " " "	
4/16	11	" " 4/15 "	" " " " "		9	" " 4/15 "	" " " " "	
4/17			Killed after 18½ hrs. Plated				Killed after 18½ hrs. Plated	
4/18	12	" " 4/17 "	" " 4 " "		10	" " 4/17	" " 4 hrs. "	Fished.
4/19	13	" " 4/18 "	" " " " "					On slant
4/20				Fished				
4/21	14	" " Culture Fished 4/20	" " " " "		11	" " Culture Fished 4/19	" " " " "	
4/22	15	" " 4/21 Plate	" " 4½ " "		12	" " 4/21 Plate	" " 5 " "	
4/23	16	" " 4/22 "	" " 4 " "		13	" " 4/22 "	" " 4 " "	
4/24	17	" " 4/23 "	" " 4½ " "		14	" " 4/23 "	" " 4½ " "	
4/25	18	" " 4/24 "	" " " " "		15	" " 4/24 "	" " " " "	
4/26				Fished	16	" " 4/25 "		Fished
4/27				On slant				
4/28	19	" " Culture Fished 4/26	" " " " "		17	" " Culture Fished 4/27	" " 4½ " "	
4/28	20	" " 4/28 Plate	" " " " "		18	" " 4/28 Plate	" " " " "	
4/30	21	" " 4/29 "	" " " " "		19	" " 4/29 "	" " " " "	
5/1				Fished				Fished
5/2	22	" " Culture Fished 5/1	" " " " "		20	" " Culture Fished 5/1	" " " " "	
5/3	23	" " 5/2 Plate	" " " " "		21	" " 5/2 Plate	" " " " "	
5/4				On plate				On plate
5/5				Fished				Fished
5/6	24	" " Culture Fished 5/5	" " " " "		22	" " Culture Fished 5/5	" " " " "	"
5/7				"				
5/8	25	2 c. c. of Culture Fished 5/7	Killed after 4 hrs. Plated		23	2 c. c. of Culture Fished 5/7	Killed after 4 hrs. Plated	
5/9				Fished	24	" " 5/8 Plate	" " " " "	
5/10	26	" " " " 5/9	" " 4½ " "		25	" " 5/9 "	" " 4½ " "	On plate
				On plate Fished				Fished

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5/13					
5/14	27	" " Culture Fished 5/12			On slant
5/15			Killed after 18 hrs.	Plated	
5/16	28	" " 5/15 Plate	" " 5 "	"	
5/17	29	" " 5/16 "	" " 4½ "	"	
5/18					
5/19					On plate
5/20	30	" " Culture Fished 5/19	" " " "	"	Fished
5/21	31	" " 5/20 Plate	" " 5 "	"	
5/22	32	" " 5/21 "	" " 4½ "	"	
5/23					
5/24					Fished
5/25					On slant
5/26	33	" " Culture Fished 5/23	" " " "	"	" "
5/27					
5/28					Fished
5/29	34	" " " " 5/27	" " " "	"	On slant
5/38					
5/31					On plate
6/1					Fished
6/2	35	" " " " 5/31	" " " "	"	On slant
6/3					
6/4	36	" " " " 6/3	" " " "	"	Fished
6/5					
6/6	37	" " " " 6/5	" " " "	"	"
6/7	38	" " 6/6 Plate	" " " "	"	
6/8					
6/9					On plate
6/10					Fished
6/11	39	" " Culture Fished 6/9	" " " "	"	On slant
6/12					
6/13	40	2 c. c. of Culture Fished 6/12	Killed after 5 hrs.	Plated	Fished
6/14					
6/15					Fished
6/16	41	" " " " 6/14	" " 4½ "	"	On slant
6/17					
6/18					Fished
6/19					
6/20					
6/21					
6/22					
6/23					
6/24					
6/25					
6/26					
6/27					
6/28					
6/29					
6/30					
7/1					
7/2					

	26	" " Culture Fished 5/12	" " 5 "	"	Fished
					On slant
	27	" " " " 5/14	" " 4½ "	"	" "
					On plate
	28	" " " " 5/19	" " " "	"	Fished
	29	" " 5/20 Plate	" " 5 "	"	
	30	" " 5/21 "	" " 4½ "	"	
	31	" " Culture Fished 5/23	" " 5 "	"	Fished
	32	" " 5/24 Plate	" " 4½ "	"	On plate
	33	" " 5/26 "	" " 5 "	"	
	34	" " Culture Fished 5/28	" " 4½ "	"	Fished
					On plate
					Fished
	35	" " " " 5/31	" " " "	"	On slant
	36	" " 6/2 Plate	" " " "	"	
	37	" " 6/3 "	" " " "	"	
	38	" " 6/4 "	" " 5 "	"	
	39	" " Culture Fished 6/6	" " 4½ "	"	Fished
	40	" " 6/7 Plate	" " 5 "	"	On plate
	41	" " Culture Fished 6/10	" " 4½ "	"	Fished
	42	2 c. c. of Culture Fished 6/12	Killed after 5 hrs.	Plated	Fished
	43	" " " " 6/14	" " 4½ "	"	Fished
					On slant
					Fished
					On slant
					" "
					" "
					" "
	44	" " " " 6/17	" " " "	"	" "
					Fished
					On slant
					" "
					" "
					" "
					" "
	45	" " " " 6/24	" " " "	"	" "
					Fished

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Virulence tests were run on each culture after the series of passages was completed. The tests were run at first in doses of 2 billion, 1 billion, and ½ billion organisms per c. c., 1 c. c. of the desired dilution being injected into each of 3 or more mice. Corresponding doses of the stock culture which had not been passed through mice were run on the same number of mice. These stock cultures are kept on serum glucose agar and transferred once a week. The suspensions were prepared from the growth on glucose agar slants, washed off, and diluted with Locke's solution. The turbidity was measured by comparison with standards of finely divided silica in suspension. These were made according to the standards set up by the United States Geological Survey for water analysis as quoted in Standard Methods of Water Analysis, American Public Health Association, edition 1917.

The density of suspension of the 500 parts per million standard had been found to represent 1 billion organisms per c. c.

On most of the strains doses of 2 billions, 1 billion, and ½ billion organisms per c. c. killed most of the mice and smaller doses of ¼ billion and sometimes ⅛ billion organisms per c. c. were run. Only the mice dying within 30 hours were considered as dying from the results of the inoculation. Where the results were not conclusive the number of mice was increased to 5 and sometimes to 10 on a dose. The tests showed that 3 of the 6 cultures had increased somewhat in virulence. Cultures Nos. 98, 136, and 300 showed no difference between the passed cultures and the stock culture. Culture No. 135 showed a decided and consistent increase in virulence, shown by the fact that from 20 to 60 per cent more of the mice survived on the stock culture in the higher dilutions than on the treated culture. Culture No. 56 showed a slight increase in virulence on the highest dilution, the number of survivors on the stock culture exceeding those on the treated strain by 20 to 40 per cent. Culture No. 301 showed an increase of 30 per cent in one of the tests on ½ billion organisms per c. c. and of 10 per cent in the test on ¼ billion organisms per c. c. The virulence tests were run as follows:

PROTOCOL No. 2.—*Results when mice were intraperitoneally injected with living meningococci after many successive mouse passages or transfers on stock culture mediums.*

NO. 98 CULTURES.

2 billion organisms.		1 billion organisms.		½ billion organisms.	
Passed culture.	Stock culture.	Passed culture.	Stock culture.	Passed culture.	Stock culture.
1. D. 5.[1] 2. D. 23. 3. D. 25.	1. D. 14. 2. D. 14. 3. D. 5.	1. D. 6. 2. D. 23. 3. Survived.	1. D. 5. 2. D. 18. 3. Survived.	1. D. 5. 2. D. 18. 3. Survived.	1. D. 5. 2. D. 4. 3. D. 10.
				1. D. 3. 2. D. 23. 3. D. 31.	1. D. 3. 2. D. 18. 3. D. 42.

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PROTOCOL No. 2.—*Results when mice were intraperitoneally injected with living meningococci after many successive mouse passages or transfers on stock culture mediums*—**Continued.**

NO. 98 CULTURES—Continued.

½ billion organisms.		⅛ billion organisms.	
Passed culture.	Stock culture.	Passed culture.	Stock culture.
1. D. 3. 2. D. 18. 3. D. 20½.	1. D. 5. 2. D. 7. 3. Survived.	1. D. 24. 2. Survived. 3. Survived. 4. Survived. 5. Survived.	1. D. 4½. 2. Lost. 3. Survived. 4. Survived. 5. Survived.
1. D. 6½. 2. D. 4½. 3. Survived. 4. Survived. 5. Survived.	1. D. 2. 2. D. 5½. 3. D. 24. 4. Survived. 5. Survived.	1. D. 9½. 2. D. 5½. 3. D. 7½. 4. Survived. 5. Survived.	1. D. 9½. 2. D. 11½. 3. D. 7½. 4. Survived. 5. Survived.

[1] "D. 5" means dead five hours after inoculation.

NO. 135 CULTURES.

2 billion organisms.		1 billion organisms.		½ billion organisms.	
Passed culture.	Stock culture.	Passed culture.	Stock culture.	Passed culture.	Stock culture.
1. D. 11. 2. D. 11. 3. D. 5.	1. D. 26. 2. D. 26. 3. D. 32.	1. D. 9. 2. Survived. 3. Survived.	1. D. 15. 2. Survived. 3. Survived.	1. D. 13. 2. D. 27. 3. Survived.	1. D. 20. 2. D. 9. 3. Survived. 4. Survived. 5. Survived. 6. Survived.
		1. D. 5½. 2. D. 7½. 3. D. 16½. 4. D. 10½. 5. D. 18½.	1. D. 10½. 2. D. 7½. 3. D. 12½. 4. D. 25. 5. Survived.	1. D. 16½. 2. D. 12½. 3. D. 10½. 4. D. 25. 5. D. 32½.	1. D. 18½. 2. D. 24. 3. Survived. 4. Survived. 5. Survived.
				1. D. 13½. 2. D. 9½. 3. D. 15½. 4. D. 24½. 5. Survived.	1. D. 9½. 2. D. 3½. 3. D. 2½. 4. Survived. 5. Survived.

½ billion organisms.		⅛ billion organisms.	
Passed culture.	Stock culture.	Passed culture.	Stock culture.
1. D. 9½. 2. D. 3½. 3. D. 11½. 4. D. 17½. 5. Survived.	1. D. 9½. 2. D. 20. 3. Survived. 4. Survived. 5. Survived.	1. D. 3. 2. D. 18. 3. Survived. 4. Survived. 5. Survived.	1. Survived. 2. Survived. 3. Survived. 4. Survived. 5. Survived.
1. D. 12. 2. D. 18. 3. D. 24. 4. Survived. 5. Survived.	1. Survived. 2. Survived. 3. Survived. 4. Survived. 5. Survived.		

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PROTOCOL NO. 2.—*Results when mice were intraperitoneally injected with living meningococci after many successive mouse passages or transfers on stock culture mediums*—Continued.

NO. 56 CULTURES.

2 billion organisms.		1 billion organisms.		½ billion organisms.	
Passed culture.	Stock culture.	Passed culture.	Stock culture.	Passed culture.	Stock culture.
1. D. 8. 2. D. 19. 3. Survived.	1. D. 19. 2. D. 19. 3. Survived.	1. D. 19. 2. Survived. 3. Survived.	1. D. 28. 2. Survived. 3. Survived.	1. D. 11½. 2. D. 5½. 3. D. 6½. 4. D. 20. 5. D. 24½.	1. D. 11½. 2. D. 6½. 3. D. 4½. 4. Survived. 5. Survived.
1. D. 16½. 2. D. 16½. 3. D. 12½. 4. D. 12½. 5. D. 12½.	1. D. 10½. 2. D. 7½. 3. D. 7½. 4. D. 12½. 5. Survived.	1. D. 8½. 2. D. 8½. 3. D. 10½. 4. D. 5½. 5. Survived.	1. D. 10½. 2. D. 14½. 3. D. 18½. 4. D. 18½. 5. Survived.	1. D. 22. 2. D. 27½. 3. Survived. 4. Survived. 5. Survived. 6. Survived. 7. Survived. 8. Survived. 9. Survived. 10. Survived.	1. Survived. 2. Survived. 3. Survived. 4. Survived. 5. Survived. 6. Survived. 7. Survived. 8. Survived. 9. Survived. 10. Survived.
		1. D. 9½. 2. D. 6½. 3. D. 5½. 4. D. 17½. 5. D. 20.	1. D. 2½. 2. D. 3½. 3. D. 11½. 4. D. 17½. 5. D. 28½.		

NO. 136 CULTURES.

2 billion organisms.		1 billion organisms.		½ billion organisms.	
Passed culture.	Stock culture.	Passed culture.	Stock culture.	Passed culture.	Stock culture.
1. D. 4½. 2. D. 26½. 3. Survived.	1. D. 22. 2. D. 24. 3. D. 26½.	1. D. 13½. 2. D. 17½. 3. Survived.	1. D. 27½. 2. D. 26½. 3. Survived.	1. D. 15½. 2. Survived. 3. Survived.	1. Survived. 2. Survived. 3. Survived.
		1. D. 11½. 2. D. 17½. 3. D. 22. 4. D. 22. 5. D. 24.	1. D. 17½. 2. D. 17½. 3. D. 27½. 4. D. 30½. 5. Survived.	1. D. 8½. 2. D. 25. 3. Survived. 4. Survived. 5. Survived.	1. 6½. 2. Survived. 3. Survived. 4. Survived. 5. Survived.
				1. Survived. 2. Survived. 3. Survived. 4. Survived. 5. Survived.	1. D. 24½. 2. D. 27½. 3. Survived. 4. Survived. 5. Survived.

NO. 300 CULTURES.

2 billion organisms.		1 billion organisms.		½ billion organisms.	
Passed culture.	Stock culture.	Passed culture.	Stock culture.	Passed culture.	Stock culture.
1. D. 4½. 2. D. 5½. 3. Survived.	1. D. 6½. 2. D. 15½. 3. Survived.	1. D. 23. 2. Survived. 3. Survived.	1. D. 13½. 2. D. 18½. 3. Survived.	1. D. 23. 2. Survived. 3. Survived.	1. D. 11½. 2. Survived. 3. Survived.
		1. D. 17½. 2. D. 27½. 3. Survived. 4. Survived. 5. Survived.	1. D. 22. 2. D. 22. 3. D. 27½. 4. D. 31½. 5. Survived.	1. D. 37½. 2. D. 25½. 3. Survived. 4. Survived. 5. Survived.	1. D. 14½. 2. D. 22. 3. Survived. 4. Survived. 5. Survived.

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PROTOCOL No. 2.—*Results when mice were intraperitoneally injected with living meningococci after many successive mouse passages or transfers on stock culture mediums*—Continued.

NO. 301 CULTURES.

2 billion organisms.		1 billion organisms.		½ billion organisms.	
Passed culture.	Stock culture.	Passed culture.	Stock culture.	Passed culture.	Stock culture.
1. D. 17½.	1. D. 3½.	1. D. 10½.	1. D. 2½.	1. D. 5½.	1. D. 4½.
2. D. 22.	2. D. 4½.	2. D. 22.	2 Survived.	2. Survived.	2. D. 4½.
3. D. 25½.	3. D. 25½.	3. Survived.	3 Survived.	3. Survived.	3. Survived.
		1. D. 5½.	1. D. 11½.	1. D. 13½.	1. D. 17½.
		2. D. 3½.	2. D. 4½.	2. D. 9½.	2. D. 8½.
		3. D. 21½.	3. D. 24.	3. D. 11½.	3. D. 21½.
		4. D. 21½.	4. D. 27½.	4. D. 5½.	4. Survived.
		5. Survived.	5. Survived.	5. Survived.	5. Survived.
				1. D. 12.	1. D. 14.
				2. D. 10.	2. D. 5.
				3. D. 12.	3. D. 7.
				4. D. 12.	4. D. 5.
				5. D. 18.	5. D. 3.
				6. D. 18.	6. D. 18.
				7. D. 24.	7. Survived.
				8. D. 24.	8. Survived.
				9. D. 25½.	9. Survived.
				10. Survived.	10. Survived.

¼ billion organisms.	
Passed culture.	Stock culture.
1. D. 4.	1. D. 8.
2. D. 15.	2. D. D. 7.
3. D. 9.	3. D. 12.
4. D. 8.	4. D. 12.
5. D. 15.	5. Survived.
6. Survived.	6. Survived.
7. Survived.	7. Survived.
8. Survived.	8. Survived.
9. Survived.	9. Survived.
10. Survived.	10. Survived.

The results of the attempts to increase the virulence of the strains of meningococci were, on the whole, disappointing, as no suggestion of the manifold increase in virulence caused by mouse passage of certain pneumococci and streptococci was observed. Even after many passages all the cultures were of rather low virulence, and, as has been referred to elsewhere, living and dead organisms showed no very striking difference as far as their fatality for mice was concerned.

COMPARISON OF LETHAL EFFECT OF LIVING AND DEAD CULTURES.

Early in our work we became impressed with the large amounts of living meningococci necessary to kill mice regularly. The work of Flexner, 1907, and others on the biology of the meningococcus made it seem more probable that the death of the mice was due

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rather to the production of some poison by the disintegration of the injected meningococci than dependent on any such rapid multiplication of these organisms as occurs, for example, in animals injected with a few virulent pneumococci. It seemed possible, therefore, that the dead organisms might be nearly as lethal as the living ones and might give more regular results in routine tests. The killing power of living and dead cultures of meningococci was therefore tested in a number of experiments, of which the following are examples. In these experiments mass cultures of the meningococci were suspended in Ringer's solution, one portion treated with ether for an hour, the suspensions standardized and injected into mice.

PROTOCOL No. 3.—*Comparison of lethal effect of living and dead meningococci on mice—Meningococcus culture No. 135 (stock culture).*

Culture, alive: 2 billion organisms injected intraperitoneally into each of 10 mice.	Culture, ether-killed: 2 billion organisms injected intraperitoneally into each of 10 mice.
No. 1. D. 40.	No. 11. Survived.
No. 2. Survived.	No. 12. Survived.
No. 3. Survived.	No. 13. D. 27.
No. 4. D. 21.	No. 14. D. 40.
No. 5. D. 24.	No. 15. Survived.
No. 6. D. 40.	No. 16. D. 40.
No. 7. Survived.	No. 17. Survived.
No. 8. D. 21.	No. 18. D. 6.
No. 9. Survived.	No. 20. Survived.
No. 10. Survived.	

Result.—Suspensions of apparently equal fatality; both killed 50 per cent of the mice.

PROTOCOL No. 4.—*Comparison of lethal effect of living and dead meningococci on mice—Meningococcus No. 57 (stock culture).*

	Culture, alive: Mice injected peritoneally with 1 c. c. amounts.		Culture, ether-killed: Mice injected intraperitoneally with 1 c. c. amounts.
Suspension containing 4 billion organisms per c. c.	No. 1. D. 40.	Suspension containing 8 billion organisms per c. c.	No. 21. D. 26.
	No. 2. Survived.		No. 22. D. 41.
	No. 3. D. 21.		No. 23. D. 20.
	No. 4. D. 17.		No. 24. D. 32.
	No. 5. D. 42.		No. 25. D. 17.
	No. 6. D. 9.		No. 26. D. 5.
	No. 7. Survived.		No. 27. D. 12.
	No. 8. Survived.		No. 28. D. 42.
	No. 9. D. 28.		No. 29. D. 7.
	No. 10. Survived.		No. 30. D. 18.
Suspension containing 1 + ½ billion organisms per c. c.	No. 11. Survived.	Suspension containing 4 billion organisms per c. c.	No. 31. Survived.
	No. 12. Survived.		No. 32. D. 30.
	No. 13. Survived.		No. 33. Survived.
	No. 14. Survived.		No. 34. D. 36.
	No. 15. Survived.		No. 35. Survived.
	No. 16. Survived.		No. 36. D. 40.
	No. 17. Survived.		No. 37. D. 13.
	No. 18. Survived.		No. 38. D. 22.
	No. 19. Survived.		No. 39. Survived.
	No. 20. Survived.		No. 40. Survived.

NOTE.—Four billion living killed 60 per cent, while 4 billion dead organisms killed 50 per cent of the mice.

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In planning this experiment and the one next following, it was considered that to be of significance the live culture ought to be fatal in at least about one-fifth of the amount of a dose of the dead culture killing all or nearly all the mice. This, however, was found not to be the case in this instance. While it required 8 billion of the dead organisms to kill all the mice, 1½ billion living organisms failed to kill a single mouse.

PROTOCOL No. 5.—*Comparison of the lethal effects of living and dead meningococci on mice. No. 56 (passage culture).*

Culture, alive: Mice injected intraperitoneally with 1 c. c. amounts.		Culture, ether-killed: Mice injected intraperitoneally with 1 c. c. amounts.	
Suspension containing 5 billion organisms per c. c.....	No. 1. D. 6.	Suspension containing 10 billion organisms per c. c.....	No. 21. D. 6.
	No. 2. D. 11.		No. 22. D. 29.
	No. 3. D. 40.		No. 23. D. 40.
	No. 4. D. 31.		No. 24. D. 24.
	No. 5. D. 25.		No. 25. D. 17.
	No. 6. Survived.		No. 26. D. 40.
	No. 7. D. 24.		No. 27. D. 40.
	No. 8. Survived.		No. 28. D. 18.
	No. 9. D. 24.		No. 29. D. 4.
	No. 10. D. 40.		No. 30. Survived.
Suspension containing 2 billion organisms per c. c.....	No. 11. Survived.	Suspension containing 5 billion organisms per c. c.....	No. 31. D. 29.
	No. 12. Survived.		No. 32. Survived.
	No. 13. D. 20.		No. 33. Survived.
	No. 14. D. 48.		No. 34. Survived.
	No. 15. D. 24.		No. 35. Survived.
	No. 16. Survived.		No. 36. D. 9.
	No. 17. D. 31.		No. 37. Survived.
	No. 18. D. 40.		No. 38. Survived.
	No. 19. D. 40.		No. 39. Survived.
	No. 20. Survived.		No. 40. D. 29.

NOTE.—The living culture here was more fatal than the dead as 5 billion living cocci killed 80 per cent of mice while 5 billion dead cocci killed 30 per cent; however, 10 billion killed organisms killed 90 per cent mice while one-fifth of this amount (2 billion living organisms) failed to kill an equal number, killing only 60 per cent.

From these and other experiments we became convinced that no very wide difference exists in the fatality of living and dead cultures for mice. Thus it would appear that the fact of the protection of mice by antimeningococcus serum is not necessarily an indication of the prevention of the multiplication of the organisms, by killing them or otherwise rendering them incapable of multiplication, but is rather an indication of some process whereby the meningococcus or its split products are rendered less poisonous for the animals. Under these conditions, protection tests where performed with living or dead cultures would really seem to be tests of the antitoxic properties of the serum against the meningococcus poison. In the performance of antitoxin tests the products of bacterial growth (toxins) are universally preferred to the use of living organisms. Thus our attention was diverted from the use of living meningococci as antigens, the more especially on account of our failure to secure virulent cultures as has been mentioned above.

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USE OF DEAD MENINGOCOCCI.

Gordon, 1918, has published material of considerable interest in regard to what he designates as the "endotoxin" of the meningococcus and the "anti-endotoxic" properties of antimeningococcus serum. This work is of especial interest as Gordon considers that the therapeutic power of the serum in the treatment of cerebrospinal fever in man bears a definite relation to this "anti-endotoxin" content as demonstrated by animal protection tests.

Gordon's methods are so explicitly described in his publications that a brief reference here suffices for present consideration. In the preparation of his "endotoxin" he follows in general the methods of Besredka, simplified as follows: "One-tenth gram of the dried and powdered meningococci was ground up in an agate mortar for about 10 minutes in 5 c. c. of distilled water and well shaken, but not centrifuged. Ten per cent ether was added as a preservative. In testing serums from 0.1 to 0.2 c. c. was measured out, 0.5 c. c. serum added thereto, and the mixture incubated at 37° C. for 30 minutes, at the end of which time the different mixtures were injected intraperitoneally into mice." With a potent toxin life or death of the mouse is the criterion (of the power of the serum to destroy the endotoxin) but with a weaker toxin the presence or absence of illness is a good index to the antitoxic value of the serum."

It was found that the powdered meningococci were fatal to mice in doses of from 2 to 10 mg. per mouse, but if suspensions of the powdered organisms in these amounts were mixed with the serums of animals which had previously been injected with meningococci in a suitable manner the mice survived. Gordon interprets this result as a neutralization of the "endotoxin" of the meningococcus by the "anti-endotoxin" of the serum.

We have been able to confirm the general facts as set forth by Gordon. We have prepared extracts and suspensions of the ground, dried meningococci, and found them toxic for mice in approximately the same amounts as Gordon. In estimating the toxicity of our materials we have felt it imperative to take into careful account the great variability in the individual mice in their power to recover from injections of these poisons. Thus, it was found that 4 or 5 mice at least must be injected with equal amounts of the poisons in order to get any definite idea of their toxicity, and as the work progressed it seemed better to use as many as 10 mice in these tests. The usual term "M. L. D." was avoided in our work, and it was found that a far greater variation occurred in the amounts necessary to kill all the mice in a given lot than in the amount necessary to kill 70, 80, or 90 per cent. These latter amounts were also better adapted to show

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difference in the protective powers of the antimeningococcus serums, as will appear later.

It seems unfortunate, in the light of what has been set forth above, that Gordon was obliged to confine himself to the use of but two mice to a dose of the poison-serum mixtures in carrying out his tests. The danger of depending upon such a small number of mice is well illustrated in an extract from one of our protocols, as follows: In this experiment constant amounts of the poison prepared from one of our stock strains of meningococci were mixed with equal amounts of normal horse serum, and with similar amounts two different samples of antimeningococcus serum. These mixtures were incubated at 37° C. for one hour and then were injected intraperitoneally into mice. Each serum-poison mixture was distributed among four mice in amounts of 1 c. c. for each mouse.

The results appear as follows:

I	Mice receiving meningococcus poison and normal horse serum.	No. 1. Dead in 11 hours. No. 2. Survived. No. 3. Dead in 22 hours. No. 4. Survived.
II	Mice receiving meningococcus poison and antimeningococcus serum No. 41.	No. 1. Dead in 32 hours. No. 2. Dead in 51 hours. No. 3. Survived. No. 4. Survived.
III	Mice receiving meningococcus poison and antimeningococcus serum No. 57.....	No. 1. Survived. No. 2. Dead in 37 hours. No. 3. Dead in 35 hours. No. 4. Survived.

In examining the above tests it will be seen that the interpretation of results might have been far different had but two mice been used in each series and the meningococcus serums might have been adjudged worthless or potent by the apparent operation of chance, the result actually being due to the variability of the resistance of the mice.

It is of course apparent that the experiment as it stands is inconclusive, but it may be of interest to note that a repetition of the test with a larger amount of the meningococcus poison clearly indicated that one of the antimeningococcus serums had some protective power, as compared with the others.

LOW POTENCY OF MENINGOCOCCUS "ENDOTOXIN."

As our work progressed we became impressed with the relatively great amounts of the dead meningococcus and its extracts necessary to kill mice with regularity. The freshness of the isolation of the strain or its passage through mice seemed to make no striking difference in regard to the toxic power of our preparations. On the other hand, certain "stock" strains regularly produced stronger poisons than others. Daily transfer of the cultures weakened the toxicity of the poisons made from them. The organisms were treated in a

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number of ways—for example, by weak sodium hydroxide or antiformin—but the resulting extracts were always weaker than others made from the untreated cocci.

In the discussion of our toxicity results it may be said that the powdered meningococci would kill 80 to 90 per cent of the mice injected in doses of from 3 to 6 mg. per mouse. Estimating 30 gm. as the average weight of our mice, the toxicity would equal from 100 to 200 mg. per kilo body weight. This is an enormous dose as compared with the toxines of diphtheria and tetanus and a large one as compared with the toxine of *B. perfringens*, which kills in amounts of 3 mg. per kilo. A number of estimates of the number of dead organisms necessary regularly to kill mice of average weights were made, and it was found that from 2 to 10 billion organisms were required. We have been impressed by the fact that the meningococcus or its "endotoxins" are really not very poisonous to mice as compared with rabbits.

In our hands, grinding the meningococci and extracting with water and injecting the extract or emulsion or organisms did not seem to produce more toxic effects than were obtained by injecting cultures freshly killed by ether, and in our work we came to substitute a method to be described subsequently, of testing the lethal powers of the dead meningococci on mice. This method seemed to us more simple and reliable than the method of Gordon.

As in the work with live cultures, we were immediately confronted with the problem of whether to use stock cultures or those which had been passed many times through mice; and, in order to settle this question, a series of experiments was devised in which mice were injected with ether-killed suspensions of cultures made from stock strains and from the same strains after repeated mouse passage. These suspensions were carefully standardized, by turbidity estimations, to be of just the same density for each stock and passage culture of each strain (an easy matter in working with the meningococcus which makes a uniform suspension in Ringer's solution). Suspensions of any required degree of density containing an equivalent number of organisms were thus prepared.

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PROTOCOL No. 6.—*Toxicity of ether-killed suspensions of meningococcus No. 56 previously passed through mice, and when carried in stock culture.*

Mouse passage culture, cultures passed through 23 mice in the past 30 days. (See Protocol No. 1.)		Stock cultures, carried over once a week on serum agar.	
Turbidity of suspensions equivalent to—	Mice injected with 1 c. c. amounts intraperitoneally.	Turbidity of suspensions equivalent to—	Mice injected with 1 c. c. amounts intraperitoneally.
10 billion organisms per c. c.	No. 1. D. 6. No. 2. D. 29. No. 3. D. 40. No. 4. D. 24. No. 5. D. 17. No. 6. D. 40. No. 7. D. 40. No. 8. D. 6. No. 9. D. 4. No. 10. Survived.	10 billion organisms per c. c.	No. 21. D. 8. No. 22. Survived. No. 23. D. 40. No. 24. D. 29. No. 25. D. 54. No. 26. D. 13. No. 27. D. 53. No. 28. D. 53. No. 29. D. 13. No. 30. D. 40.
5 billion organisms per c. c.	No. 11. D. 29. No. 12. Survived. No. 13. Survived. No. 14. Survived. No. 15. Survived. No. 16. Survived. No. 17. D. 9. No. 18. Survived. No. 19. Survived. No. 20. D. 29.	5 billion organisms per c. c.	No. 31. D. 27. No. 32. D. 18. No. 33. Survived. No. 34. Survived. No. 35. Survived. No. 36. Survived. No. 37. Survived. No. 38. Survived. No. 39. Survived. No. 40. Survived.

PROTOCOL No. 7.—*Toxicity of ether-killed suspensions of meningococcus, No. 58, previously passed through mice and when carried in stock culture.*

Mouse passage culture, cultures passed through 17 mice in past 33 days. (See Protocol No. 1.)		Stock cultures, carried over once a week on serum agar.	
Turbidity of suspensions equivalent to—	Mice injected intraperitoneally with 1 c. c. amounts.	Turbidity of suspensions equivalent to—	Mice injected intraperitoneally with 1 c. c. amounts.
10 billion organisms per c. c.	No. 1. D. 5. No. 2. D. 9. No. 3. D. 9. No. 4. D. 9. No. 5. D. 3. No. 6. D. 37. No. 7. D. 9. No. 8. D. 6. No. 9. D. 25. No. 10. D. 1.	10 billion organisms per c. c.	No. 21. D. 16. No. 22. D. 33. No. 23. D. 33. No. 24. D. 13. No. 25. D. 24. No. 26. D. 22. No. 27. D. 27. No. 28. D. 35. No. 29. D. 11. No. 30. D. 1.
5 billion organisms per c. c	No. 11. D. 17. No. 12. D. 16. No. 13. D. 5. No. 14. Survived. No. 15. Survived. No. 16. D. 17. No. 17. D. 29. No. 18. D. 13. No. 19. D. 7. No. 20. Survived.	5 billion organisms per c. c.	No. 31. D. 3. No. 32. Survived. No. 33. D. 9. No. 34. Survived. No. 35. D. 9. No. 36. D. 15. No. 37. D. 4. No. 38. Survived. No. 39. D. 4. No. 40. D. 34.

The above protocols are typical of the series in showing no significant difference in the toxicity of the ether-killed organisms from stock cultures or after animal passage.

Inasmuch as it is necessary to know the toxicity of each suspension before making protection tests (and, with a culture of unknown virulence this takes at least 48 hours' time for observation on the fate

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of the injected mice) it was hoped that the etherized suspensions would prove to be fairly stable as regards their toxicity for that period when kept cold. That our hopes were justified may be seen from the following protocols:

PROTOCOL No. 8.—*Toxicity of equal amounts of ether-killed suspensions of meningococcus No. 56, when freshly injected, and when kept for 48 hours at 15° C.*

Portion of suspension injected immediately after preparation and treatment with ether for 1 hour.		Portion of suspension injected after being treated with ether for 48 hours and kept at 15° C.	
Original turbidity of suspension adjusted equivalent to—	Mice injected intraperitoneally with 1 c. c. amounts.	Original turbidity of suspension adjusted equivalent to—	Mice injected intraperitoneally with 1 c. c. amounts.
10 billion organisms per c. c.....	No. 1. D. 18. No. 2. Survived. No. 3. D. 40. No. 4. D. 29. No. 5. D. 54. No. 6. D. 13. No. 7. D. 53. No. 8. D. 53. No. 9. D. 13. No. 10. D. 40.	10 billion organisms per c. c.....	No. 11. D. 30. No. 12. D. 30. No. 13. D. 30. No. 14. D. 34. No. 15. D. 30. No. 16. D. 22. No. 17. D. 25. No. 18. D. 26. No. 19. D. 20. No. 20. D. 33.
Microscopic examination of the suspension shows clear-cut, well staining cocci. Turbidity: 1 c. c. suspension and 8.5 c. c. Ringer's solution equivalent to 10 billion organisms per c. c.		Microscopic examination of the suspension shows shadow forms and detritus and a few poorly stained cocci. Turbidity: 1 c. c. suspension and 3.5 c. c. Ringer's solution equivalent to 10 billion organisms per c. c.	

PROTOCOL No. 9.—*Toxicity of equal amounts of ether-killed suspensions of meningococcus No. 58, when freshly injected, and when kept for 48 hours at 15° C.*

Original turbidity of suspension adjusted to be equivalent to—	Mice injected intraperitoneally with 1 c. c. amounts.	Original turbidity of suspension adjusted to be equivalent to—	Mice injected intraperitoneally with 1 c. c. amounts.
5 billion per c. c.....	No. 1. D. 6. No. 2. D. 29. No. 3. D. 40. No. 4. D. 24. No. 5. D. 17. No. 6. D. 40. No. 7. D. 40. No. 8. D. 18. No. 9. D. 4. No. 10. Survived.	5 billion per c. c.....	No. 11. D. 24. No. 12. D. 20. No. 13. D. 30. No. 14. D. 40. No. 15. D. 29. No. 16. D. 29. No. 17. D. 20. No. 18. D. 22. No. 19. D. 20. No. 20. D. 20.
Microscopic examination of the suspension shows clear-cut and well staining cocci. Turbidity: 1 c. c. suspension + 6.5 c. c. Ringer's solution equivalent to 10 billion organisms per c. c.		Microscopic examination of the suspension shows shadow forms and detritus and a few poorly stained cocci. Turbidity: 1 c. c. suspension and 3 c. c. Ringer's solution equivalent to 10 billion organisms per c. c.	

The above protocols illustrate our findings that the suspensions treated with ether may be kept 48 hours with marked disintegration of the organisms as evidenced by the microscopic appearances and the loss in turbidity, but may still retain their toxicity. In spite we consider it preferable to use suspensions freshly prepared

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from cultures of known virulence, as being more uniform than the preserved suspensions which have been allowed to disintegrate.

The preparations of these suspensions may now be briefly described as follows:

1. Inoculate several serum agar slants in large test tubes from stock meningococcus cultures not undergoing transfer more often than once a week.

2. Incubate 14 to 20 hours at 37° C.; examine microscopically for purity. If pure, add 7 c. c. sterile broth to each tube. Emulsify the growth and distribute the growth from each tube between two large Blake bottles containing serum agar (3 per cent agar); cover the surface of the agar with the emulsion by tilting gently.

3. Incubate about 20 hours. Remove water of condensation and remains of seed culture with a sterile pipette. Introduce about 7 c. c. sterile Ringer's solution into each bottle with a sterile pipette. Wash off and remove growth to a small, sterile, glass-stoppered bottle. Remove a small portion for microscopical examination and turbidity testing and add about 10 per cent ether; keep at 15° C. for 1 hour; transfer to large, wide-mouthed beaker and warm at 37° for 10 minutes to drive off ether, when the emulsion is ready for dilution and injection into mice.

While the emulsion is being exposed to ether the portion removed is examined microscopically for purity and if found pure is tested for turbidity. This is done as follows: Four ordinary homeopathic vials of exactly equal diameter are selected, and into three of these are distributed diluted portions of the United States Geological Survey turbidity standard, made up as described in Standard Methods of Water Analysis of the American Public Health Association, 1917, equaling 200, 250, and 300 parts per million, respectively; to the fourth vial is added a known portion of the emulsion to be standardized, and this is diluted with a measured amount of Ringer's solution or normal salt solution until the density of the suspension just equals that in the vial containing 250 parts per million (this is accurately and rapidly done by placing the vials side by side in a small metal rack in front of ordinary newspaper print). The amount of Ringer's solution necessary to add to secure any desired concentration in terms of the turbidity standard is now calculated and this is expressed in terms of meningococci in the suspension by assuming that a turbidity of 500 parts per million is equivalent to 1 billion organisms per c. c.

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PROTECTION OF MICE BY ANTIMENINGOCOCCUS SERUM.

We have been able to protect mice against dead meningococci or their extracts by mixing these with antimeningococcus serum before injecting, and we found that normal horse serum, or, for example, antipneumococcus serum, did not possess this property.

This property of antimeningococcus serum is illustrated as follows: In the first experiment cited, the meningococci were prepared by Gordon's method as described above, the emulsion centrifuged, and the clear, supernatant, watery extract used in the tests, as was done in some of Gordon's earlier work. Portions of the watery extract were mixed with normal horse serum and with two samples of antimeningococcus (horse) serum in the proportion of 0.6 c. c. of the extract to 0.4 c. c. serum and placed in the 37° incubator for half an hour. One c. c. of the mixture was injected into a series of mice. Upon removing the mixture from the incubator, a marked positive precipitin reaction was noted as indicated below. Previous to incubation all the mixtures were perfectly clear.

PROTOCOL No. 9.—*Protective effects on mice by mixing antimeningococcus serum with watery extracts of meningococcus No. 58 as compared with normal horse serum.*

Normal horse serum+. Meningococcus extract.	Mice injected intraperitoneally with 1 c. c. amounts.	Antimeningococcus serum, No. 41.+ Meningococcus extract.	Mice injected intraperitoneally with 1 c. c. amounts.	Antimeningococcus serum, No. 57.+ Meningococcus extract.	Mice injected intraperitoneally with 1 c. c. amounts.
	No. 1. D. 9. No. 2. D. 9. No. 3. D. 5. No. 4. Survived.		No. 5. D. 7. No. 6. Survived. No. 7. D. 5. No. 8. Survived.		No. 9. D. 17. No. 10. Survived. No. 11. Survived. No. 12. Survived.

Strong precipitin test with serum No. 57; none in others; serum No. 57 agglutinates group of No. 58 higher than does No. 41 serum (as 4 is to 3).

In the next experiment cited our method of using the dead cultures preserved with ether, as is described above, was used. The toxicity of the ether-killed organisms was first determined and the suspension used after being exposed to ether 48 hours at 15° C. Mice were first injected with ½ c. c. of the different serums, and at the expiration of 40 minutes again injected with ½ c. c. of meningococcus suspension. Ten mice received no serum, but only the coccal suspensions.

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PROTOCOL No. 10.—*Protective effects on mice by injecting them with antimeningococcus serum previous to injecting them with ether-killed suspensions of meningococcus No. 135, as compared with normal horse serum and antipneumococcus serum.*

[Meningococcus suspension containing 9 billion organisms per ½ c. c. (dose for each mouse ½ c. c..).]

No serum.	Normal horse serum; no preservative.	Normal horse serum; 0.5 per cent of phenol.
Mice. No. 1. D. 29. No. 2. Survived. No. 3. D. 3. No. 4. D. 7. No. 5. D. 26. 20 per cent survived.	*Mice.* No. 6. D. 18. No. 7. D. 18. No. 8. D. 18. No. 9. D. 31. No. 10. D. 40. None survived.	*Mice.* No. 11. D. 20. No. 12. D. 33. No. 13. D. 42. No. 14. D. 22. No. 15. D. 26. None survived.
Antimeningococcus serum, No. 63.	**Antimeningococcus serum, No. 64.**	**Antipneumococcus serum, No. 75.**
Mice. No. 16. D. 26. No. 17. Survived. No. 18. Survived. No. 19. D. 29. No. 20. Survived. 60 per cent survived.	*Mice.* No. 21. Survived. No. 22. D. 6. No. 23. Survived. No. 24. Survived. No. 25. D. 43. 60 per cent survived.	*Mice.* No. 26. D. 5. No. 27. D. 3. No. 28. D. 26. No. 29. D. 27. No. 30. D. 32. None survived.

[Meningococcus suspension containing 3 billion organisms per ½ c. c. (dose for each mouse ½ c. c.).]

No serum.	Normal horse serum; no preservative.	Normal horse serum; 0.5 per cent of phenol.
Mice. No. 31. Survived. No. 32. D. 18. No. 33. D. 20. No. 34. D. 20. No. 35. Survived. 40 per cent survived.	*Mice.* No. 36. D. 7. No. 37. Survived. No. 38. D. 19. No. 39. D. 7. No. 40. Survived. 40 per cent survived.	*Mice.* No. 41. D. 20. No. 42. Survived. No. 43. D. 40. No. 44. D. 40. No. 45. D. 20. 20 per cent survived.
Antimeningococcus serum, No. 63.	**Antimeningococcus serum, No. 64.**	**Antipneumococcus serum, No. 75.**
Mice. No. 46. Survived. No. 47. Survived. No. 48. D. 24. No. 49. Survived. No. 50. Survived. 80 per cent survived.	*Mice.* No. 51. D. 29. No. 52. Survived. No. 53. Survived. No. 54. Survived. No. 55. Survived. 80 per cent survived.	*Mice.* No. 56. D. 29. No. 57. Survived. No. 58. D. 29. No. 59. D. 29. No. 60. D. 31. 20 per cent survived.

These two experiments illustrate the protective property of antimeningoccocus serums as compared with normal horse serums and antipneumococcus serum, but it was found that the dose of the meningococcus poison must be adjusted with great delicacy in order to bring out protective properties on the part of the serums tested. Thus, a dose which may kill all the control mice may fail to show any protective properties, but a smaller dose than this may bring out protective effects of the antimeningococcus serum, still killing all the control mice. This is illustrated in the following experiment in which a watery extract was prepared as by Gordon's method. Fourtenths c. c. of the serums was mixed with 0.2 and 0.8 c. c. of the watery extract, incubated at 37° C. for half an hour and then injected into

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mice as follows. Observations were also made on precipitin reactions:

PROTOCOL No. 11.—*Protective effect on mice by injecting them with antimeningococcus serum mixed with watery extracts of meningococcus No. 98 as compared with normal horse serum.*

	Normal horse serum.	Antimeningococcus serum, No. 41.	Antimeningococcus serum, No. 42.	Antimeningococcus serum, No. 57.
	Mice.	*Mice.*	*Mice.*	*Mice.*
0.2 c. c. extract..	No. 1. D. 32.	No. 5. D. 6.	No. 9. Survived.	No. 13. D. 5.
	No. 2. D. 4.	No. 6. D. 2.	No. 10. D. 5.	No. 14. D. 18.
	No. 3. D. 13.	No. 7. D. 7.	No. 11. Survived.	No. 15. D. 28.
	No. 4. D. 18.	No. 8. D. 30.	No. 12. Survived.	No. 16. Survived.
0.8 c. c. extract..	No. 17. D. 10.	No. 21. D. 6.	No. 25. D. 18.	No. 29. D. 24.
	No. 18. D. 24.	No. 22. D. 18.	No. 26. D. 5.	No. 30. D. 5.
	No. 19. D. 8.	No. 23. D. 8.	No. 27. D. 6.	No. 31. D. 6.
	No. 20. D. 19.	No. 24. D. 11.	No. 28. D. 9.	No. 32. D. 9.

Precipitin tests; with 0.2 c. c. extract+normal serum, none; serum 41, slight; serum 42, marked: serum 57, marked.

NOTE.—With 0.8 c. c.+the various serums no precipitin reactions visible.

With serum No. 42 and 0.2 c. c. extract, 3 out of 4 mice were protected, while none survived which received normal serum, but when 0.8 c. c. extract was used all died. This indicates a fundamental limitation to the test, as it appears difficult or impossible to grade serums quantitatively when the limits in which the test must be performed are so narrow. It appears that in working with the dead meningococcus or its extracts it is not possible to say that a certain quantity of serum will protect against 10, 20, or 100 lethal doses as can be done with true toxines. All that can be said is that one serum has protective properties while another has none.

The large amounts of poisons necessary to use in meningococcus serum protection tests further introduces a probable element of uncertainty in so far as the injection of considerable amounts of protein may give rise to nonspecific reactions neither dependent on, nor controlled by, the specific antibodies in the antimeningococcus serum which we wish to test.

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TREASURY DEPARTMENT
UNITED STATES PUBLIC HEALTH SERVICE

HYGIENIC LABORATORY—BULLETIN No. 125
AUGUST, 1920

DIGEST OF COMMENTS
ON
THE PHARMACOPŒIA OF THE UNITED STATES OF AMERICA
AND ON THE
NATIONAL FORMULARY

FOR THE CALENDAR YEAR
ENDING DECEMBER 31
1917

By

A. G. DuMEZ

WASHINGTON
GOVERNMENT PRINTING OFFICE
1920

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Assistant Bacteriologist Liston A. Steffin, B. S.

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TABLE OF CONTENTS.

Page.

Preface 9

List of the literature reviewed:

1. Title abbreviations—Journals 13
2. Title abbreviations—Pharmacopœias and nonofficial standards 20

I. General comments:

1. Legal status and development—
   1. Pure food and drug laws 21
   2. Sale and use of poisons 22
   3. Sale and use of narcotic drugs 23
   4. Sale and use of household remedies 26
   5. Drug inspection work 27
   6. The Pharmacopœia as a legal standard 28
   7. Supplement to the Pharmacopœia 29
   8. United States Pharmacopœial Convention 29
   9. General principles to be followed in revising the Pharmacopœia 30
   10. Publication and control 30
   11. The physician and the Pharmacopœia 30
   12. Value of criticism 31
   13. Committee of revision 31
   14. Nature and progress of revision 32
2. Scope—
   1. Nature and content of the Pharmacopœia 33
   2. The Pharmacopœia as a textbook 35
   3. A limited materia medica 35
   4. Nomenclature 35
   5. Doses 36
   6. Antidotes 36
   7. Weights and measures 37
   8. Objects and uses 39
   9. Additions and deletions 39
   10. Purity and strength 39
   11. Atomic weights 40
3. Nonpharmacopœial standards—
   1. National Formulary 41
   2. Recipe book 42
   3. New and nonofficial remedies 43
      - Synthetics 44
      - New remedies 44
      - Patents and trade-marks 45
      - Chemotherapy 47
      - Radioactivity 48
   4. Biological products 50
      - Enzymes 51
      - Organotherapy 52
      - Serums and vaccines 52
      - Biological methods and tests 55
   5. Antiseptics and disinfectants 61

Digitized by Google

I. General comments—Continued. Page.
4. Analytical data ... 63
1. Adulterations ... 64
2. Reagents and test solutions ... 64
3. Volumetric solutions ... 68
4. Indicators ... 68
5. Physical constants ... 69
Specific gravity ... 69
Solubilities ... 70
Melting point determinations ... 71
Boiling point determinations ... 72
Thermometry ... 72
Polarization and refraction ... 72
6. Chemical constants ... 73
7. Apparatus ... 73
8. Filters ... 77
9. Color standards and colors ... 77
10. Analytical methods and results ... 78
11. Tests ... 83
Halogens ... 83
Hydrogen sulphide ... 85
Sulphur, sulphates, and sulphites ... 85
Phosphorus and phosphates ... 85
Nitrogen, nitrates, and nitrites ... 86
Ammonia ... 87
Carbon and carbonates ... 87
Alkali compounds ... 88
Alkaline earth compounds ... 89
Antimony and arsenic ... 89
Metals ... 90
Organic compounds ... 92
Sugar ... 94
12. Diagnostic reagents and clinical tests ... 95
Urine ... 96
Acidity ... 99
Acetone ... 99
Albumin ... 100
Ammonia ... 101
Bile ... 101
Blood ... 101
Chlorides ... 102
Indican ... 102
Sulphur ... 102
Sugar ... 102
Urea ... 104
Uric acid ... 104
Feces ... 104
Gastric contents ... 105
Blood ... 105
Stains ... 107
Culture media ... 108
5. Vegetable drugs ... 110
1. Cultivation of medicinal plants ... 114
2. Powdered drugs ... 115

Digitized by Google

I. General comments—Continued.
5. Vegetable drugs—Continued. Page.
3. Moisture determinations ... 115
4. Ash determinations ... 116
5. Glucosides ... 116
6. Alkaloids ... 116
7. Miscellaneous plant constituents ... 118
8. Assay processes ... 121
9. Physiological standardization ... 123
6. Pharmaceutical preparations ... 124
1. General formulas ... 125
2. Standardization ... 125
3. Galenicals ... 126
Deterioration ... 127
4. Incompatibility ... 127
5. Extraction ... 128
6. Sterilization ... 128
7. Forms of administration ... 129
Ampoules ... 129
Capsules ... 130
Compressed tablets ... 130
II. International standards:
1. The evolution of uniformity in pharmacopœial standards and for potent medicaments ... 130
1. Adoption of Brussels Conference Protocol ... 130
2. Foreign pharmacopœias ... 131
1. British ... 131
2. Norwegian ... 131
3. Italian ... 131
4. Swiss ... 131
5. Dutch ... 132
6. Brazilian ... 132
7. Danish ... 132
III. Comments on official articles ... 132

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PREFACE.

This compilation of references to the literature on subjects of interest with respect to the revision of the Pharmacopœia of the United States of America and the National Formulary constitutes the thirteenth number in the series of Digest of Comments.

In this, as in the previous numbers, an effort has been made to present in a brief, concise form working references to all published articles relating directly or indirectly to the official drug standards mentioned above. With this object in view, all the available chemical, medical, and pharmaceutical periodicals and reports have been carefully reviewed and abstracted. In those cases in which the periodical containing the original article was not available, as was frequently the case with certain foreign publications which have not been regularly received in this country since the beginning of the war, the reader has been referred to the journal in which an abstract of the article appeared. This procedure was thought to be preferable to withholding the comment until some future date when the periodical containing the original article might become available.

The relation of the Pharmacopœia to public-health work is becoming more and more evident, as shown by the attention being devoted in pharmacopœias generally to the materials and tests employed in clinical laboratories and to the standardization of disinfectants and biologics. In this connection, the enormous increase in the use of arsenicals, as a result of the antivenereal disease campaigns being waged in all civilized countries, is also important. For this reason a fairly comprehensive compilation of references to the literature on these subjects has also been included in this bulletin. These references should prove to be of more than ordinary value to officials engaged in public health work.

As heretofore, an attempt has been made to record the comments on foreign pharmacopœias and standards. Work on the European standards, however, appears to have been greatly curtailed as the result of the war, since there has been comparatively little published along this line during the past year. This condition becomes significant when we take into consideration the fact that only 19 of all the national pharmacopœias have been revised since 1900, and only the Argentine pharmacopœia, of all the standards of the South

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American States, has been revised in this century. Among the few important items of general interest in this connection there may be mentioned the appearance of a commentary on the Norwegian pharmacopœia, the increased interest in the revision of the Swiss pharmacopœia, which was last revised in 1907, and the advocation of the publication of a Brazilian pharmacopœia by the medical congress recently held at Sao Paulo. References to the available literature on foreign standards are given under the headings designated by the names of the respective pharmacopœias.

The stimulus given to experiments in the cultivation of medicinal plants in this and other countries as a result of the war in Europe is still noticeable, as evidenced by the numerous articles and treatises on the subject which have been published during the past year. In fact, the experimental stage in the cultivation of a number of the more important drug plants has already been passed, and they are now being produced in this country on a commercial scale—e. g., belladonna, stramonium, digitalis, cannabis, etc. References to published articles of this nature are included under a separate heading entitled "Cultivation of Medicinal Plants."

In addition to the foregoing an effort has been made to reflect the literature on legal matters which may have an indirect or future value in connection with the revision of the two official drug standards heretofore mentioned. For this reason abstracts of the more important articles dealing with food and drug laws, poison laws, antinarcotic laws, the sale and use of household remedies, and drug-inspection work have been included. Comments of this nature are, in greater part, grouped under separate headings, but may occur under comments on official articles when they have a specific application, as is frequently the case with the items relating to drug-inspection work.

For the information of those who may not be familiar with the nature of the bulletins of this series, attention is directed to the fact that the space devoted to a reference is not infrequently in inverse proportion to its recognized importance, though some idea of the nature and value of the original article may be obtained from its length as indicated by the page reference. In order to learn accurately a given writer's ideas or the content of his paper, the original communication should be consulted whenever practicable. The intent in the preparation of these abstracts has been to call attention to the character and scope of the original paper rather than to record its actual content.

In conclusion, the compiler desires to express the appreciation of the bureau to the publishers and editors of the journals, periodicals, and reports furnished in exchange; to the secretaries of State and pharmaceutical organizations for copies of their annual

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proceedings; to John Uri Lloyd, of Cincinnati, for copies of the eclectic medical journals; to the editor of Chemical Abstracts for the loan of several publications; and to the officers of the library of the Department of Agriculture, the library of the Office of the Surgeon General of the Army, Washington, and the Library of Congress for the use of reports and periodicals not on file in this laboratory.

A. G. D.

DIVISION OF PHARMACOLOGY,
HYGIENIC LABORATORY,

January 23, 1920.

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LIST OF THE LITERATURE REVIEWED.

1. TITLE ABBREVIATIONS—JOURNALS.

Abstr. Bact.—Abstracts of Bacteriology, Baltimore, 1917, v. 1.
Am. Druggist.—American Druggist and Pharmaceutical Record, New York, 1917, v. 65.
Am. Food J.—American Food Journal (The), Chicago, 1917, v. 12.
Am. J. Clin. Med.—American Journal of Clinical Medicine, 1917, v. 24.
Am. J. Dis. Children.—American Journal of Diseases of Children, 1917, v. 15.
Am. J. M. Sc.—American Journal of the Medical Sciences, Philadelphia, 1917, v. 153.
Am. J. Pharm.—American Journal of Pharmacy, Philadelphia, 1917, v. 89.
Am. J. Physiol.—American Journal of Physiology, Boston, 1917, v. 42, 43.
Am. J. Public Health.—American Journal of Public Health, 1917, v. 7.
Am. J. Sc.—American Journal of Science, New Haven, 1917, v. 43, 44.
Am. J. Syphilis.—American Journal of Syphilis, 1917, v. 1.
Am. Med.—American Medicine, 1917, v. 23.
Am. Perf.—The American Perfumer and Essential Oil Review, 1917, v. 11, Nos. 11–12, and v. 12, Nos. 1–10.
Am. Rev. Tuberculosis.—American Review of Tuberculosis, 1917, v. 1.
Anales soc. española fis. quim.—Anales de la sociedad española de fisica y quimica, Madrid, 1915, v. 13.
Anales soc. quim. Argentina.—Anales Sociedad quimica, Argentina, 1917, v. 5.
Analyst (The), London, 1917, v. 42.
Ann. Bot.—Annals of Botany, London, 1917, v. 31.
Ann. chim. analyt.—Annales de chimie analytique, Paris, 1917, v. 22.
Ann. chim. applicata.—Annali di chimica applicata, Roma, 1917, v. 7, 8.
Ann. Falsif.—Annales de falsifications, Paris, 1917, v. 10.
Ann. inst. Pasteur.—Annales de l'Institut Pasteur, Paris, 1917, v. 31.
Apothecary (The), Boston, 1917, v. 29.
Apoth.-Ztg.—Apotheker-Zeitung, Berlin, 1916, v. 31; 1917, v. 32.
Arch. Chem. Mikros.—Archiv für Chemie und Mikroskopie, Wien, 1916, v. 9. Nos. 1 and 2.
Arch. exper. Path. u. Pharmakol.—Archiv für experimentelle Pathologie und Pharmakologie, 1917, v. 80, 81.
Arch. farmacol. sper.—Archivio di farmacologia sperimentale e Scienze affini, Roma, 1917, v. 23, 24.
Arch. Int. Med.—Archives (The) of Internal Medicine, Chicago, 1917, v. 19.
Arch. med. pharm. mil. Paris.—Archives de medicine et de pharmacie militaires, Paris, 1917, v. 67, 68.
Arch. med. pharm. nav. Paris.—Archives de medicine et pharmacie navales, Paris, 1917, v. 103, 104.
Arch. Pharm. Chem.—Archiv for Pharmaci og Chemi, Copenhagen, 1917, v. 24.
Atti accad. Lincei.—Atti della reale accademie dei Lincei, 1917, v. 26.
Biochem. J.—Biochemical Journal, Liverpool, 1917, v. 11.
Boll. chim. farm.—Bolletino Chimico-Farmaceutico, Milan, 1917, v. 56.
Boston M. & S. J.—Boston Medical and Surgical Journal, 1917, v. 176, 177.

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Bot. Gaz.—Botanical Gazette, Chicago, 1917, v. 63, 64.
Brit. Food J.—British Food Journal, London, 1917, v. 19.
Brit. M. J.—British Medical Journal, London, 1917, v. 1, 2.
Bull. Arizona Bd. Health.—Bulletin of the Arizona State Board of Health, 1917, v. 6.
Bull. Assoc. Gén. Syn. Pharm. France.—Bulletin de l'Association Générale des Syndicats Pharmaceutiques de France, 1917, v. 20.
Bull. Bur. Stand.—Bulletins of the Bureau of Standards, Department of Commerce, 1917, v. 13.
Bull. California Bd. Health.—Monthly Bulletin of the California State Board of Health, 1917.
Bull. Connecticut Agric. Exper. Sta.—Bulletin of the Connecticut Agricultural Experiment Station, 1917, Nos. 190–200.
Bull. Connecticut Bd. Health.—Monthly Bulletin of the Connecticut State Board of Health, Hartford, 1917, v. 31.
Bull. Florida Bd. Health.—Bulletin of the Florida State Board of Health, Jacksonville, 1917, v. 12.
Bull. Georgia Dept. Agric.—Bulletins of the Georgia Department of Agriculture, 1917, v. 4, Nos. 1, 5.
Bull. Hyg. Lab.—Bulletins, Hygienic Laboratory, U. S. Public Health Service, 1917, No. 110.
Bull. Illinois Bd. Health.—Bulletin of the Illinois State Board of Health, Springfield, 1917, v. 3.
Bull. Imp. Inst.—Bulletin of the Imperial Institute, London, 1917, v. 15.
Bull. Indiana Bd. Health.—Monthly Bulletin of the Indiana State Board of Health, Indianapolis, 1917, v. 20.
Bull. Iowa Bd. Health.—Bulletin, Iowa State Board of Health, Des Moines, 1917.
Bull. Kansas Bd. Health.—Bulletin of the Kansas State Board of Health, 1917, v. 12, 13.
Bull. Kentucky Agric. Exper. Sta.—Bulletin of the Kentucky Agricultural Experiment Station, 1917.
Bull. Kentucky Bd. Health.—Bulletin of the State Board of Health of Kentucky, 1917, v. 7.
Bull. Lab. Inl. Rev. Dept. Canada.—Bulletins of the Laboratory of the Inland Revenue Department, Ottawa, Canada, 1917.
Bull. Louisiana Bd. Health.—Quarterly Bulletin of the Louisiana State Board of Health, 1917, v. 8.
Bull. Maine Bd. Health.—Bulletin of the State Board of Health of Maine, Augusta, 1917, v. 4.
Bull. Massachusetts Bd. Health.—Bulletin of the Massachusetts State Board of Health, 1917, v. 4.
Bull. Michigan Bd. Health.—Public Health published by the Michigan State Board of Health, Lansing, 1917.
Bull. Michigan D. & F. Dept.—Bulletin of the Michigan Dairy and Food Department, 1917, Nos. 256–267.
Bull. Mississippi Bd. Health.—Health Bulletin of the Mississippi State Board of Health, Jackson, 1917, v. 6, 7.
Bull. Montana Bd. Health.—Bulletin (special) of the Montana State Board of Health, Helena, 1917.
Bull. Montana Dept. Pub. Health.—Bulletin of the Department of Public Health of the State of Montana, Helena, 1917.
Bull. New Hampshire Bd. Health.—Quarterly Bulletin of the State Board of Health of New Hampshire, 1917, v. 5, Nos. 1–5.
Bull. New Jersey Agric. Exper. Sta.—Bulletin of the New Jersey Agricultural Station, N[illegible]wick, 1917, No. 304.

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Bull. New Jersey Dept. Health.—Public Health News Bulletin, Department of Health of the State of New Jersey, 1917, v. 2.

Bull. New York Agric. Exper. Sta.—Bulletin of the New York Agricultural Experiment Station, Geneva, 1917, No. 433, 434, 435, 439.

Bull. New York Dept. Health.—Bulletin of the New York State Department of Health, 1917, v. 12.

Bull. New York City Dept. Health.—Bulletin of the New York City Department of Health, 1917, v. 6.

Bull. North Carolina Bd. Health.—Bulletin of the Carolina State Board of Health, 1917, v. 32.

Bull. North Dakota Bd. Health.—Bulletin of the North Dakota State Board of Health, 1917, v. 10.

Bull. North Dakota Exper. Sta. F. Dept.—Bulletin (special) of the Food Department of the North Dakota Agricultural Experiment Station, 1917, v. 4.

Bull. N. W. D. A.—Bulletin of the National Wholesale Druggists' Association, 1917.

Bull. Ohio Bd. Health.—Bulletin of the Ohio State Board of Health, 1917, v. 8.

Bull. Pharm.—Bulletin of Pharmacy, Detroit, 1917, v. 31.

Bull. Porto Rico Agric. Exper. Sta.—Bulletin of the Porto Rico Agricultural Experiment Station, 1917.

Bull. Rhode Island Bd. Health.—Bulletin of the Rhode Island State Board of Health, 1917, v. 3.

Bull. sc. pharmacol.—Bulletin des sciences pharmacologiques, Paris, 1917, v. 24.

Bull. soc. chim. France.—Bulletin de la société chimique de France, 1917, v. 21, 22.

Bull. soc. pharm. Bordeaux.—Bulletin des travaux de la Société de Pharmacie de Bordeaux, 1917, v. 55.

Bull. South Dakota F. & D. Dept.—Bulletin of the South Dakota Food and Drug Department, 1917, v. 4, 5.

Bull. U. S. Dept. Agric.—Bulletins of the U. S. Departemnt of Agriculture, 1917.

Bull. Vermont Bd. Health.—Bulletin of the Vermont State Board of Health, 1917, v. 17, Nos. 3. 4; v. 18, Nos. 1, 2.

Bull. West Virginia Bd. Health.—Bulletin of the West Virginia Public Health Council, 1917, v. 4.

Bull. Wyoming Agric. Exper. Sta.—Bulletin of the University of Wyoming Agriculture Experimental Station, 1917, No. 112.

Bur. Mines Tech. Papers.—U. S. Bureau of Mines Technical Papers, 1917, No. 181.

Canadian Pharm. J.—Canadian Pharmaceutical Journal, Toronto, 1917, v. 50, 51.

Centralb. f. Bakteroil.—Centralblatt für Bakteriologie, Parasitenkunde und Infectsionskrankheiten, Jena, 1917, v. 79, Nos. 5, 6, 7.

Chem. Abstr.—Chemical Abstracts, Easton, Pa., 1917, v. 11.

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Chem. & Drug.—Chemist and Druggist, London, 1917, v. 89.

Chem. & Drug. Australas.—Chemist and Druggist of Australasia, Sydney, and Melbourne, 1917, v. 32.

Chem. Eng.—Chemical Engineer, Chicago, 1917, v. 25.

Chem. News.—Chemical News, London, 1917, v. 115, 116.

Chem. Weekblad.—Chemisch Weekblad, Amsterdam, 1917, v. 14.

Circ. Bur. Stand.—Circulars of the Bureau of Standards, U. S. Department of Commerce, 1917.

Com. Rep.—Commerce Reports, Daily Circular and Trade Reports issued by the Bureau of Foreign and Domestic Commerce of the United States Department of Commerce, 1917.

Compt. rend. acad, sc.—Comptes rendus hebdomadaires des séances de l'Academie des sciences, Paris, 1917, v. 164, 165.

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Critic and Guide, New York, 1917, v. 20.
C. U. C. P. Alumni J.—Columbia University College of Pharmacy Alumni Journal, New York, 1917, v. 24.
D.-A. Apoth.-Ztg.—Deutsch-Amerikanische Apotheker-Zeitung, New York, 1917, v. 38.
Drug and Chem. Markets.—Drug and Chemical Markets, 1917.
Drug. Circ.—Druggists Circular, 1917, v. 61.
Drug Topics, New York, 1917, v. 32.
Exper. Sta. Record.—Experiment Station Record, U. S. Department of Agriculture, 1917, v. 36, 37.
Farm. Españ.—La Farmacia Española, Madrid, 1917, v. 49.
Giorn. farm. chim.—Giornale di farmacia, di chimica e di scienze affini, Torino, 1916, v. 65; 1917, v. 66.
Japanese Med. Lit.—Japanese Medical Literature, 1917, v. 2.
J. Agric. Research.—Journal of Agricultural Research, 1917, v. 8, 9, 10, 11.
J. Am. Chem. Soc.—Journal of the American Chemical Society, Easton, Pa., 1917, v. 39.
J. Am. Inst. Homeop.—Journal of the American Institute of Homeopathy, Chicago, 1917, v. 9, 10.
J. Am. M. Assoc.—Journal of the American Medical Association, Chicago, 1917, v. 68, 69.
J. Am. Pharm. Assoc.—Journal of the American Pharmaceutical Association, Philadelphia, 1917, v. 6.
J. Am. Vet. Med. Assoc.—Journal of the American Veterinary Medical Association, Ithaca, 1917, v. 50.
J. Assoc. Off. Agric. Chem.—Journal of the Association of Official Agricultural Chemists, Baltimore, 1917, v. 2, No. 4.
J. Bact.—Journal of Bacteriology, Baltimore, 1917, v. 1, 2.
J. Biol. Chem.—Journal of Biological Chemistry, New York, 1917, v. 27–32.
J. Chem. Soc. Lond.—Journal of the Chemical Society, London, 1917, v. 111, 112.
J. chim. phys.—Journal de chimie physique, Genève et Paris, 1917, v. 15.
J. Exper. M.—Journal of Experimental Medicine, New York, 1917, v. 25, 26.
J. H. Hosp. Bull.—Johns (The) Hopkins Hospital Bulletin, Baltimore, 1917, v. 28.
J. Immunol.—Journal of Immunology, Baltimore, 1917, v. 2.
J. Ind. & Eng. Chem.—Journal (The) of Industrial and Engineering Chemistry, Easton, Pa., 1917, v. 9.
J. Infec. Dis.—Journal (The) of Infectious Diseases, Chicago, 1917, v. 20, 21.
J. Jamaica Agric. Soc.—Journal (The) of the Jamaica Agricultural Society, 1917, v. 21.
J. Lab. & Clin. Med.—Journal (The) of Laboratory and Clinical Medicines, St. Louis, 1916–17, v. 2.
Journal-Lancet.—The Journal Lancet, The Journal of the Minnesota State Medical Association and Official Organ of the North Dakota and South Dakota State Medical Associations, Minneapolis, 1916, v. 36.
J. Linnean Soc. Bot.—Journal of the Linnean Society, Botany, 1917, v. 44.
J. Med. Research.—Journal of Medical Research, Boston, 1917, v. 35, 36.
J. Path. and Bact.—Journal (The) of Pathology and Bacteriology, Cambridge University, 1917, v. 21.
J. pharm. et chim.—Journal de pharmacie et de chimie, Paris, 1917, v. 14, 15, 16.
J. Pharmacol. & Exper. Therap.—Journal of Pharmacology and Experimental Therapeutics, Baltimore, 1917, v. 9, 10.
J. Pharm. Soc. Japan.—Journal of the Pharmaceutical Society of Japan (Yakugakuzasshi), Tokyo, 1917, No. 419, 421.

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J. Phys. Chem.—Journal (The) of Physical Chemistry, Ithaca, 1917, v. 21.
J. Physiol.—Journal (The) of Physiology, London, 1917, v. 51.
J. physiol. et path. gén.—Journal de physiologie et de pathologie générale, Paris, 1917, v. 17.
J. Proc. Roy. Soc. New South Wales.—Journal and Proceedings of the Royal Society of New South Wales, 1917, v. 51.
J. Roy. Micros. Soc.—Journal of the Royal Microscopical Society, 1917.
J. Roy. Soc. Arts—Journal of the Royal Society of Arts, London, 1917, v. 65.
J. Soc. Chem. Ind.—Journal of the Society of Chemical Industry, London, 1917, v. 36.
J. Trop. Med. & Hyg.—Journal (The) of Tropical Medicine and Hygiene, London, 1917, v. 20.
J. Washington Acad. Sc.—Journal of the Washington Academy of Sciences, 1917, v. 7.
Kolloid-Ztschr.—Kolloid-Zeitschrift, Dresden and Leipzig, 1917, v. 20, Nos. 3, 5.
Lancet (The), London, 1917, v. 192, 193.
Med. Rec.—Medical Record, New York, 1917, v. 91, 92.
Merck's Rep.—Merck's Report, New York, 1917, v. 26.
Meyer Bros. Drug.—Meyer Brothers Druggist, St. Louis, 1917, v. 38.
Midl. Drug.—Midland Druggist and Pharmaceutical Review, Columbus, 1917, v. 51.
Montreal Pharm. J.—Montreal Pharmaceutical Journal, 1917, v. 28.
Mulford's Vet. Bull.—Mulford's Veterinary Bulletin, Philadelphia, 1917, v. 8.
N. A. R. D. J.—Journal (The) of the National Association of Retail Druggists, Chicago, 1917, v. 23, 24, 25.
Nat. Drug Clerk.—National (The) Drug Clerk, Chicago, 1917, v. 5.
Nat. Druggist.—National (The) Druggist, St. Louis, 1917, v. 47.
Nat. Eclect. M. Assoc. Quart.—National (The) Eclectic Medical Association Quarterly, Cincinnati, 1917, v. 9.
Nature, London, 1917, v. 98, 99, 100.
New Idea (The), Detroit, 1917, v. 39.
New Orleans Med. & Surg. J.—New Orleans Medical and Surgical Journal, 1917, v. 69, 70.
New York M. J.—New York Medical Journal, 1917, v. 105, 106.
Norges Apotek. Tidsskr.—Norges Apotekerforenings Tidsskrift, Kristiania, 1917, v. 25, No. 1.
Off. Insp. Maine Agric. Exper. Sta.—Official Inspections, Maine Agricultural Experiment Station, 1917, Nos. 81–85.
Off. Reg. Iowa Pharm. Assoc.—Official Register Iowa Pharmaceutical Association, 1917.
Oil, Paint & Drug Rep.—Oil, Paint and Drug Reporter, New York, 1917, v. 91, 92.
Pacific Pharm.—Pacific (The) Pharmacist, San Francisco, 1917, v. 10, 11.
Pennsylvania Med. J.—Pennsylvania Medical Journal, Athens, 1917, v. 20.
Perf. & Ess. Oil Rec.—Perfumery and Essential Oil Record, London, 1917, v. 8.
Pharm. Era.—Pharmaceutical (The) Era, New York, 1917, v. 50.
Pharm. J.—Pharmaceutical Journal (The), London, 1917, v. 98, 99.
Pharm. Post.—Pharmazeutische Post, Vienna, 1917, v. 50, Nos. 10–11, 20–23, 34–45, 47–51, 56–63.
Pharm. Weekblad.—Pharmaceutisch Weekblad, Amsterdam, 1917, v. 54.
Philippine J. Sc.—Philippine (The) Journal of Science, Manila, 1917, v. 12.
Phil. Mag.—The London, Edinburgh, and Dublin Philosophical Magazine and Journal of Science, 1917, v. 33, 34.
Physiol. Abstr.—Physiological Abstracts, London, 1917, v. 2.
Pop. Sci. Monthly.—Popular (The) Science Monthly, 1917, v. 90, 91.
Pract. Drug.—Practical (The) Druggist and Pharmaceutical Review of Reviews, New York, 1917, v. 35.

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Practitioner (The), London, 1917, v. 98, 99.
Presse medicale, Paris, 1917, v. 25.
Proc. Am. Drug Mfg. Assoc.—Proceedings of the American Drug Manufacturers Association, 1917.
Proc. Nat. Acad. Sci.—Proceedings of the National Academy of Sciences, Washington, 1917, v. 3.
Proc. N. W. D. A.—Proceedings of the National Wholesale Druggists' Association, New York, 1917.
Proc. Roy. Soc. Lond.—Proceedings of the Royal Society, London, 1917, v. 93, 94.
Proc. Soc. Exper. Biol. & Med.—Proceedings of the Society for Experimental Biology and Medicine, 1917, v. 14.
Proceedings of State pharmaceutical associations:
Proc. Alabama Pharm. Assoc., 1917.
Proc. California Pharm. Assoc., 1917.
Proc. Connecticut Pharm. Assoc., 1917.
Proc. Florida Pharm. Assoc., 1917.
Proc. Georgia Pharm. Assoc., 1917.
Proc. Illinois Pharm. Assoc., 1917.
Proc. Kansas Pharm. Assoc., 1917.
Proc. Kentucky Pharm. Assoc., 1917.
Proc. Louisiana Pharm. Assoc., 1917.
Proc. Maine Pharm. Assoc., 1917.
Proc. Maryland Pharm. Assoc., 1917.
Proc. Michigan Pharm. Assoc., 1917.
Proc. Minnesota Pharm. Assoc., 1917.
Proc. Missouri Pharm. Assoc., 1917.
Proc. Nebraska Pharm. Assoc., 1917.
Proc. New Hampshire Pharm. Assoc., 1917.
Proc. New Jersey Pharm. Assoc., 1917.
Proc. New York Pharm. Assoc., 1917.
Proc. North Carolina Pharm. Assoc., 1917.
Proc. North Dakota Pharm. Assoc., 1917.
Proc. Pennsylvania Pharm. Assoc., 1917.
Proc. South Carolina Pharm. Assoc., 1917.
Proc. South Dakota Pharm. Assoc., 1917.
Proc. Texas Pharm. Assoc., 1917.
Proc. Tri-State Pharm. Assoc., Mississippi, Arkansas, and Tennessee, 1917.
Proc. Utah Pharm. Assoc., 1917.
Proc. Vermont Pharm. Assoc., 1917.
Proc. Washington Pharm. Assoc., 1917.
Proc. Wisconsin Pharm. Assoc., 1917.
Public Health Rep.—Public Health Reports, Washington, 1917, v. 32, Nos. 1–52.
Pure Products, New York, 1917, v. 13.
Répert. pharm.—Répertoire de Pharmacie, Paris, 1917, v. 28, part 2.
Rep. Connecticut Agric. Exper. Sta.—Report of the Connecticut Agricultural Experiment Station, 1917.
Rep. District of Columbia Health Off.—Report of the Health Officer of the District of Columbia, Washington, 1917.
Rep. Florida Bd. Health.—Twenty-eighth Annual Report of the State Board of Health of Florida, 1917.
Rep. Maine Agric. Exper. Sta.—Thirty-third Annual Report of the Maine Agricultural Experiment Station, 1917.
Rep. Minnesota D. & F. Com.—Sixteenth Biennial Report of the Minnesota State Dairy and Food Commissioner, 1917.

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Rep. Missouri Bd. Pharm.—Eighth Annual Report of the Missouri Board of Pharmacy, 1917.
Rep. Missouri F. & D. Com.—Annual Report of the Food and Drug Commissioner to the Governor of the State of Missouri, 1917.
Rep. Nevada Agric. Exp. Sta.—Report of the Nevada Agricultural Experiment Station, 1917.
Rep. New Jersey Bd. Pharm.—Sixteenth Annual Report of the Board of Pharmacy of the State of New Jersey, 1917.
Rep. New Jersey Dept. Health.—Forty-first Annual Report of the Department of Health of the State of New Jersey, 1917.
Rep. North Dakota Bd. Pharm.—Thirty-second Annual Report of the North Dakota State Board of Pharmacy, 1917.
Rep. Pennsylvania Bd. Pharm.—Twenty-ninth Annual Report of the State Pharmaceutical Examining Board of Pennsylvania, Harrisburg, 1917.
Rep. Rhode Island Bd. Pharm.—Forty-seventh Annual Report of the Rhode Island State Board of Pharmacy, Providence, 1917.
Rep. Rhode Island F. & D. Com.—Eighth Annual Report of the Board of Food and Drug Commissioners, Rhode Island, 1917.
Rep. South Carolina Com. Agric. Com. & Ind.—Fourteenth Annual Report of the Commissioner of Agriculture, Commerce, and Industries of the State of South Carolina, Columbia, 1917.
Rep. South Dakota F. & D. Com.—Seventeenth Annual Report of the Food and Drug Commissioner of South Dakota, 1917.
Rep. Tennessee F. & D. Dept.—Annual Report of the Food and Drug Department State of Tennessee, 1917.
Rep. Virginia D. & F. Com.—Quarterly Report of the Dairy and Food Commissioner of Virginia, Richmond, 1917.
Rep. Wyoming D. F. & O. Com.—Thirteenth Annual Report of the Dairy, Food, and Oil Commissioner, 1917.
Retail Druggist, Detroit, 1917, v. 24.
Rev. chim. industrielle.—La revue de chimie industrielle, Paris, 1917, v. 26.
Rev. Farm.—Revista Farmaceutica, Buenos Aires, 1917, v. 60, Nos. 2, 6, 9.
Rocky Mountain Druggist (The), Denver, 1917, v. 31.
Schweiz. Apoth.-Ztg.—Schweizerische Apotheker-Zeitung, Zurich, 1917, v. 55.
Science, New York, 1917, v. 45, 46.
Science Progress, 1917, v. 11, 12.
Sci. Am.—Scientific American, 1917, v. 116, 117.
Sci. Papers Bur. Stand.—Scientific Papers Bureau of Standards, U. S. Department of Commerce, 1917.
Simmons' Spice Mill, New York, 1917, v. 40.
Southern Med. J.—Southern Medical Journal, 1917, v. 10.
Southern Pharm. J.—Southern Pharmaceutical Journal, Dallas, 1917, v. 9, 10.
Spatula (The), Boston, 1917, v. 23, 24.
S. R. A.—Chem.—Service and Regulatory Announcements, United States Department of Agriculture, Bureau of Chemistry, 1917.
Svensk farm. Tidskr.—Svensk farmaceutisk Tidskrift, Stockholm, 1917, v. 21.
Svensk kem. Tidskr.—Svensk kemis Tidskrift, Stockholm, 1917, v. 29.
Tech. Papers Bur. Stand.—Technologic Papers of the Bureau of Standards U. S. Department of Commerce, 1917.
Therap. Gaz.—Therapeutic Gazette, Detroit, 1917, v. 41.
Virginia Pharmacist (The), Richmond, 1917, v. 1, 2.
Western Druggist (The), Chicago, 1917, v. 39.
West. Pennsylvania Ret. Drug.—Western Pennsylvania Retail Druggist, 1917.
Wis. Med. J.—Wisconsin (The) Medical Journal, Milwaukee, 1917, v. 15, 16.

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Wyoming Farm. Bulletin.—University of Wyoming Agricultural College and United States Department of Agriculture cooperating. 1917, v. 6, Nos. 7–12 and v. 7, Nos. 1, 2.

Yearbook of Pharmacy (and Transactions of the British Pharmaceutical Conference), London, 1917.

Zentralbl. Biochem. u. Biophys.—Zentralblatt für Biochemie und Biophysik, Berlin, 1917, v. 19, Nos. 1–10.

Ztschr. anal. Chem.—Zeitschrift für analytische Chemie. Wiesbaden, 1917, v. 56, Nos. 3, 5, 6, 7.

Ztschr. angew. Chem.—Zeitschrift für angewandte Chemie, Leipzig, 1917, v. 30, part 1, Nos. 30, 32–52, 54, 65–66, 68–70.

Ztschr. anorg. Chem.—Zeitschrift für anorganische und allgemeine Chemie, Leipzig, 1917, v. 99, Nos. 2, 3.

2. TITLE ABBREVIATIONS—PHARMACOPŒIAS AND NONOFFICIAL STANDARDS.

Ph. Arg. I.—Farmacopea Nacional Argentina, primera edicón, 1898.
Ph. Austr. VIII.—Pharmacopœa Austriaca, editio octava, 1906.
Ph. Belg. III.—Pharmacopœa Belgica, editio tertia, 1906.
Ph. Brit. V.—British Pharmacopœia, 1914.
Ph. Chil. I.—Farmacopea Chilena, 1886.
Ph. Dan. VIII.—Pharmacopœia Danica, 1907.
Ph. Fenn. V.—Pharmacopœa Fennica, editio quinta, 1914.
Ph. Fr. V.—Pharmacopée Francaise, Codex Medicamentarius, 1908.
Ph. Germ. V.—Pharmacopœa Germanica, editio quinta, 1910.
Ph. Helv. IV.—Pharmacopœa Helvetica, editio quarta, 1907.
Ph. Españ. VII.—Farmacopea oficial Española, septima edicion, 1905.
Ph. Hung. III.—Pharmacopœa Hungarica, editio tertia, 1909.
Ph. Ital. III.—Farmacopea ufficale del Regno d'Italia, terza edizione, 1909.
Ph. Japon. III.—The Pharmacopœia of Japan, 1906 (English translation, 1907).
Ph. Mex. IV.—Farmacopea Mexicana, cuarta edición, 1904.
Ph. Ndl. IV.—Pharmacopœa Nederlandica, editio quarta, 1905.
Ph. Norv. IV.—Pharmacopœa Norvegica, editio quarta, 1913.
Ph. Rom. III.—Pharmacopea Romana, editio tertia, 1893.
Ph. Ross. VI.—Pharmacopœa Rossica, sixth edition, 1910.
Ph. Serv. II.—Pharmacopœia Serbica, editio secunda, 1908.
Ph. Suec. IX.—Pharmacopœa Svecica, editio nona, 1908.
Ph. Ven. I.—Farmacopea Venezolana, 1898.
U. S. P. IX.—Pharmacopœia of the United States, 9th Dec. Rev., 1916.
N. F. IV.—The National Formulary of Unofficial Preparations, Baltimore, 1916.
N. N. R.—New and Nonofficial Remedies, Chicago, 1919.
B. P. C.—British Pharmaceutical Codex, London, 1911.

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DIGEST OF COMMENTS ON THE PHARMACOPŒIA OF THE UNITED STATES OF AMERICA AND ON THE NATIONAL FORMULARY.[1]

I. GENERAL COMMENTS.

1. LEGAL STATUS AND DEVELOPMENT.

1. PURE FOOD AND DRUG LAWS.

Alsberg, C. L.: A short report on the progress made by the Bureau of Chemistry in the enforcement of the food and drugs act in its relation to pharmacy.—J. Am. Pharm. Assoc. 1917, v. 6, p. 468–469.

Anon.: In the opinion of the Bureau of Chemistry an article sold under a name recognized in the index, but not appearing in the text, of the United States Pharmacopœia is a drug in the meaning of section 6 of the Federal food and drugs act. Such an article is adulterated under the provisions of the act if it differs from the standard of strength, quality, or purity as determined by tests laid down in the United States Pharmacopœia official at the time of investigation, unless its own standard of strength, quality, or purity is plainly stated upon the bottle or box or other container.—Meyer Bros. Drug., 1916, v. 37, p. 68.

Woodruff, C. M.: A discussion of the evils resulting from permitting various departments of the Government to make rules and regulations for the enforcement of laws.—Proc. Am. Drug Mfg. Assoc., 1917, p. 71–73.

Penick, S. B.: When the Federal food and drugs act became effective, it looked rather dark for the future of the crude drug business; but, as was foreseen by a few, the measure proved very successful from a commercial viewpoint, and the standards of to-day stand as a protection to the merchant wishing to conduct his business upon ethical lines.—J. Am. Pharm. Assoc., 1917, v. 6, p. 697.

Anon.: Under the new plan manufacturers may guarantee their products on the invoice for bill of sale, or by certain other methods; but, according to the food inspection provision which became effective November 1, 1916, they can not make any statement of this nature on the labels of packages of food or drugs which enter interstate or foreign commerce.—Nat. Drug., 1917, v. 47, No. 1, p. 3.

Anon.: Every effort should be made to remove temptation from the men who have an appetite for strong drink, and one tempter to

[1] Manuscript submitted for publication February 3, 1920.

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go first should be the label indicating the alcoholic strength of various articles for sale in the drug stores.—Virginia Pharm., 1917, v. 2, p. 81.

Anon.: The N. A. R. D. has adopted a resolution to the effect that this association reiterate its previously professed stand in favor of an amendment to section 7 of the Federal food and drugs act, which would abolish the iniquitous double standard for official medicines, or for any medication bearing an official title.—Apothecary, 1917, v. 29, No. 11, p. 44.

Editorial: It is stated that the formula-disclosure law recently enacted in the Philippine Islands has given rise to the wholesale counterfeiting of many standard patent and proprietary remedies.—Nat. Drug., 1917, v. 47, No. 1, p. 4.

Woodruff, C. M.: Objection is raised to the provisions of H. R. 15914, as they give the Secretary of Agriculture complete control of the preparation of viruses, serums, toxins, and analagous products intended for use in the treatment of domestic animals, leaving the producer no practical remedy against arbitrary, unjust, and malicious action.—Proc. Am. Drug Mfg. Assoc., 1917, p. 76.

2. SALE AND USE OF POISONS.

Woodruff, C. M.: The National Drug Trade Conference at a recent meeting adopted a resolution unanimously indorsing the Kern-Doremus bill as the one adequate measure to give relief to art, industry, and science respecting the mailing of legitimate articles which, though poisonous or containing poisons, are not outwardly or of their own force dangerous to life, health, and property, and may be mailed with entire safety.—Proc. Am. Drug Mfg. Assoc., 1917, p. 74; Oil, Paint & Drug Rep., 1917, v. 91, No. 4, p. 17.

Editorial: For a long time past it has been felt that a Federal poison law is needed. Such a law would not alone serve as a model to determine what is a poison, but would, if based on authentic information bearing on the existing use and abuse of poisonous drugs, be an incentive for strict adherence to the provisions of the act, at least in connection with articles offered for interstate commerce.—Pract. Drug., 1917, v. 35, No. 9, p. 18; Merck's Rep., 1917, v. 26, p. 1–2.

Anon.: A review of a brochure by C. Crinon on the recent laws regulating the sale of poisonous substances in France.—J. pharm. et chim., 1917, v. 16, p. 191.

Editorial: The attention of the retail drug trade is directed to a letter received from the New York Society for the Prevention of Vice. The letter is in the nature of a warning to retail druggists to discontinue in the future to sell articles for the prevention of conception and all preparations or drugs for causing unlawful abortions.—Am. Druggist, 1917, v. 65, No. 3, p. 23.

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Kuhn, Charles F.: A discussion of the druggists' status in relation to regulating and dispensing emmenagogues and remedies for venereal diseases.—J. Am. Pharm. Assoc., 1917, v. 6, p. 532–535.

3. SALE AND USE OF NARCOTIC DRUGS.

Anon.: Text of the internal revenue tax draft to control the manufacture and sale of narcotic drugs in the United States.—Oil, Paint & Drug Rep., 1917, v. 91, No. 11, p. 17.

Editorial: Since the enactment of the so-called Harrison law the responsibility for controlling the sale of narcotics has been largely left with the Federal officers. States which were formerly active in apprehending violators have apparently assumed that their duties in this regard are ended. Perhaps this view would be justified if the Harrison law met all of the requirements, but in its present form adequate control is hardly possible without the individual aid of each State.—Virginia Pharm., 1917, v. 1, p. 86.

Editorial: The evidence presented at the hearings held by the New York State Narcotic Committee seems to establish the fact that the narcotic evil is spreading, notwithstanding the satisfactory results which have been derived from the enforcement of the Harrison antinarcotic law and the Boylan Act of the State.—Pharm. Era, 1917, v. 50, p. 2.

Editorial: The main cause of the spread of illicit drug distribution in the State of New York, following the strict regulation of legal distribution by the Harrison antinarcotic law, was found to be the constant demand from the addict, cut off by law from his necessary supply of narcotics.—Oil, Paint & Drug Rep. 1917, v. 91, No. 20, p. 13; see also p. 18.

Editorial: Any effective regulation of the traffic in narcotic drugs must be dual, in that it must be participated in by both the Nation and the States as individual governmental entities. The regulation of sale under the State laws must be strict enough to control completely the illicit distributor and do away with the itinerant peddler, even though it may call for the enactment of legislation making the illicit sale of such drugs a felony instead of a misdemeanor.—Oil, Paint & Drug Rep. 1917, v. 91, No. 1, p. 13.

Editorial: At the hearings of the legislative committee held in New York City, Syracuse, and Buffalo on the narcotic evil, the evidence presented showed conclusively that only a small portion of the drugs used for illegitimate purposes passed through the hands of the retail drug trade.—Am. Druggist, 1917, v. 65, No. 1, p. 22.

Editorial: As the Harrison law has been found wanting in several instances, it should be amended so that it may be as effective as possible within the confines of the Federal Constitution.—Apothecary, 1917, v. 14, No. 1, p. 10.

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Lynn, Charles J.: It is recommended that the National Drug Trade Conference take up the matter of drafting a model State narcotic law which will fully supplement the Federal law, so that our laws on this subject, both Federal and State, may be uniform.—Proc. Am. Drug Mfg. Assoc. 1917, p. 28.

Woods, Arthur: The only possible way to stamp out the illicit trade in narcotics is through some sort of Federal legislation that will control the manufacture, sale, importation, exportation, and distribution of all habit-forming drugs.—Oil, Paint & Drug Rep. 1917, v. 92, No. 20, p. 21.

Towns, Charles B.: The responsibility for the use of habit-forming drugs should be put squarely up to the physician. The physician ought to be held to strict accountability for every drug he prescribes and administers. It is not right that the sick should be either imposed upon by the unscrupulous doctor or unnecessarily exposed to the dangers in the taking of such drugs when prescribed by the conscientious but ill-advised medical practitioner.—Pharm. Era, 1917, v. 50, p. 14.

Wood, Horatio C.: In a discussion of some of the results of the Harrison antinarcotic law, the author states that at present the greatest gains against the illegitimate use of narcotic drugs can be made through proper legislation. It is also stated that, although some 19 or 20 States have antinarcotic laws harmonizing more or less closely with the Harrison Act, there is need not only for prohibitive legislation in the remaining States but also for amendments to stop up the holes which clever rogues have found.—J. Am. Pharm. Assoc. 1916, v. 5, p. 1205–1208.

Anon.: A reprint of the principal features of a Federal taxing measure proposed for the control of traffic in narcotic drugs intended to meet the exigencies caused by the Supreme Court invalidation of the punitive clause in the Harrison antinarcotic act.—Drug. Circ. 1917, v. 61, p. 252.

Anon.: The failure of the Harrison law to provide for the keeping of a record of the importation of narcotic drugs into this country has been suggested as one of the probable weaknesses of that measure, and demands for an amendment covering this point were made by the National Drug Trade Conference at its recent convention in Washington City.—Drug. Circ. 1917, v. 61, p. 59.

Anon.: At the sixth annual meeting of the American Drug Manufacturers' Association, it was urged that the National Drug Trade Conference call a meeting of delegates from all organized agencies interested, including Government officials, to determine what amendments are necessary to strengthen the Harrison Act.—Bull. Pharm. 1917, v. 31, p. 90.

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Anon.: That the ultimate solution of the stupendous problem of the illicit distribution of narcotic drugs may require that all habit-forming drugs shall be manufactured or distributed by the Federal Government are findings of the New York Society for the Prevention of Crime, as stated in the annual report of the superintendent.—Oil, Paint & Drug Rep. 1917, v. 91, No. 5, p. 16.

Anon.: The N. A. R. D. has adopted a resolution to the effect that this association oppose any and all propositions to amend the Harrison Act until such time as the necessity for any change has been clearly proven.—Apothecary, 1917, v. 29, No. 11, p. 44.

Anon.: In a short discussion of the deficiencies of our present narcotic laws, it is stated that the strict control of traffic in narcotic drugs is a matter of State, Federal, and international law; not State alone.—Drug. Circ. 1917, v. 61, p. 171.

Anon.: What are known as underground channels account for the distribution of most of the narcotics illegally sold.—Meyer Bros. Drug. 1917, v. 38, p. 145.

Towns, Charles B.: The drug habit may be established just as easily by taking paregoric daily, as by taking morphine straight by the mouth in small quantities; yet at the present time druggists have a perfect legal right to sell this preparation without a prescription in any quantity they may see fit.—Pharm. Era, 1917, v. 50, p. 14.

Anon.: The great danger in the use of habit-forming drugs makes it important that a law be enacted forbidding the manufacture and sale of any patent medicine containing opium or any of its derivatives or preparations.—Rep. Rhode Island Bd. Pharm. 1917, p. 5.

Anon.: The American Association of Pharmaceutical Chemists at its annual meeting passed a resolution discouraging the use of heroin in medicinal preparations which may tend to encourage drug addiction.—Oil, Paint & Drug Rep. 1917, v. 91, No. 26, p. 17.

Collins, C. F.: The narcotic drug situation. A study of the cases in the courts of special sessions of New York during three months showed the following: Heroin cases, 258; opium cases, 110; morphine cases, 29; cocaine cases, 27.—Apothecary, 1917, v. 14, No. 2, p. 22.

Anon.: A bill recently introduced by United States Senator Phelan would amend the Harrison law making the possession of narcotics prima facie evidence of guilt.—Oil, Paint & Drug Rep. 1917, v. 91, No. 20, p. 19.

Anon.: A short synopsis of the Whitney narcotic law recently passed by the Legislature of the State of New York.—Drug. Circ. 1917, v. 61, p. 225–226.

Anon.: A synopsis of a new antinarcotic bill recently introduced in the Pennsylvania Legislature.—Drug. Circ. 1917, v. 61, p. 151.

Anon.: A royal proclamation, dated December 11, 1916, prohibits the importation of cocaine and opium into England excepting under license.—J. Soc. Chem. Ind. 1917, v. 36, p. 45.

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Anon.: Changes in the French laws governing the sale and use of narcotics as they apply to the pharmacist.—Bull. Assoc. gén. Syn. pharm. France, 1917, v. 20.

4. SALE AND USE OF HOUSEHOLD REMEDIES.

Veterri, James R.: There are strong reasons relative to the public welfare which make it proper that regulations covering the sale of drugs and medicines should not be confined to poisons, but should be extended to embrace what are known as harmless household remedies.—Meyer Bros. Drug. 1917, v. 38, p. 382.

Eckstein, A. J.: In an article, entitled "The Manufacture of Your Own Preparations," the author gives a number of reasons why the pharmacist should prepare all of the household remedies sold under his own name.—Northwestern Druggist (The), 1917, v. 18, No. 10, p. 23–24.

Newcomb, Edwin L.: One of the greatest factors which has encouraged self-medication during recent years is the stocking of homes with medicinal compounds by vendors and peddlers.—Proc. Minnesota Pharm. Assoc. 1917, p. 61–62.

Editorial: The legislation concerning the publishing of quantitative formulas for all proprietaries, now pending in a number of States, is said to be obnoxious and uncalled for.—Bull. Pharm. 1917, v. 31, p. 92–93.

Leverty, J. A.: A discussion of the desirability of the publication of the potent drug content of all ready-made medicines.—J. Am. Pharm. Assoc. 1917, v. 6, p. 356–359.

Beal, J. H.: The propaganda of the much-criticized patent medicine manufacturer has been the most effective force in preserving popular faith in the curative powers of medicines.—Bull. Pharm. 1917, v. 31, p. 458.

Griebel, C.: Memoranda bearing on the investigation of certain remedies and nostrums.—Chem. Abstr. 1917, v. 11, p. 1256, from Ztschr. Nahr.-Genussm. 1916, v. 31, p. 246–254.

McCaw, William J.: The great danger in the use of habit-forming drugs makes it important that a law be enacted forbidding the manufacture and sale of any patent medicine containing opium or any of its derivatives or preparations.—Rep. Rhode Island Bd. Pharm. 1917, p. 5.

Anon.: The law of the Philippine Islands regarding the importation and sale of patent and proprietary medicines, enacted February 27, 1917, and amended March 9, 1917, requires that the quantitative and qualitative formula must appear on the label of the bottle or immediate container unless intended for use exclusively for cosmetic purposes. Furthermore, before any patent or proprietary medicine may be offered for sale, it must be analyzed and favorably reported

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on by the bureau of science.—Oil, Paint & Drug Rep. 1917, v. 92, No. 28, p. 81.

Anon.: Consul Ely E. Palmer, Madrid, and Consul Percival Gassett, Malaga, state that the Spanish sanitary regulations (art. 66, par. 3) prohibit the sale of medicinal preparations of all kinds unless the formula is stated on the containers and labels and is listed in the Spanish pharmacopœia.—Am. Druggist, 1917, v. 65, No. 3, p. 60.

Anon.: Report No. 76 of Foreign and Domestic Commerce, Bureau of Special Consular Reports, entitled "Proprietary Medicine and Ointment Trade in China," gives suggestions on methods of selling and distributing patent medicines in China, a field which has not heretofore been covered by American exporters.—Com. Rep. 1917, No. 79, p. 55.

5. DRUG INSPECTION WORK.

Rusby, H. H.: Report of the committee on quality of drugs of the American Pharmaceutical Association. The reporters note that in consequence of the war many drugs and medicinal products have deteriorated in quality.—J. Am. Pharm. Assoc., 1917, v. 6, p. 307 and 408.

Anon.: A section recently added to article 8 of the Sanitary Code of the city of New York assigns to the New York department of health the duty of looking after the cleanliness of drug stores and the quality and cleanliness of medicines therein.—Oil, Paint & Drug Rep. 1917, v. 91, No. 4, p. 17.

Defelice, Lucas F.: A study of infant foods with respect to their composition and food value.—Rev. Farm. 1917, v. 60, p. 631–657.

Dohme, A. R. L.: Sharp & Dohme report that of 5,406 shipments received from August 15, 1916, to August 15, 1917, only 25 were rejected.—Proc. N. W. D. A. 1917, p. 506.

Dohme, A. R. L.: Powers-Weightmann-Rosengarten Co. report that all their crude material, including cinchona bark, opium, iodine, nux vomica, brimstone, salt, citrus materials and other raw materials, drugs, and chemicals have been found up to the usual standards during the year.—Proc. N. W. D. A. 1917, p. 508.

Anon.: Of 172 samples of crude drugs assayed 147 were above standard and 25 were below standard.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 92.

Barnard, H. E.: Of 212 samples of drugs examined, 11 were rejected, as they did not come up to the standard.—Bull. Indiana Bd. Health, 1917, v. 20, p. 135, 148, 159, 172, 184, 196, 207, and 221.

Casey, F. W.: Of 386 samples of drugs examined, 144 were rejected.—Bull. Michigan D. & F. Dept. 1917, No. 256–257, p. 16; No. 258–259, p. 18; No. 260–261, p. 33; No. 262–263, p. 13.

Congdon, Leon A.: Of 4,840 samples of drug and medicine examined between 1905 and May 1, 1917, 58.18 per cent were legal and 41.82

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were illegal and questionable.—Proc. Kansas Pharm. Assoc. 1917, p. 86.

Eskew, Harry L.: Of 179 samples of drugs examined, 72 were rejected.—Rep. Tennessee F. & D. Dept., 1917, p. 15.

Hortvet, Julius: Of 121 samples of extracts and essential oils examined, 44 were rejected.—Rep. Minnesota D. & F. Com., 1917, p. 53.

Ladd, E. F.: Ninety-four of 310 drug stores inspected in North Dakota during 1917 received a passing grade.—Bull. North Dakota Exper. Sta., F. Dept., 1917, v. 4, p. 439.

Lea, E. J.: Of 226 drugs and pharmaceutical preparations examined, 106 were rejected.—Rep. California Bd. Health, 1917, p. 162.

Pozen, M. A.: Of 186 samples of drugs examined, 125 were rejected.—Rep. District of Columbia Health Off., 1917, p. 50–51.

Street, John Phillips: The examination of drug products obtained from the stocks of dispensing physicians showed that 22 of 111 samples of tablets were deficient, and that 8 of 18 samples of solutions were unsatisfactory.—Rep. Conn. Agric. Exper. Sta., 1917, p. 161–191.

Tice, William G.: Of 454 samples of drugs examined, 121 were below standard.—Rep. New Jersey Dept. Health, 1917, p. 62.

Todd, A. R.: Of 122 samples of drugs examined, 42 were rejected.—Bull. Michigan D. & F. Dept., 1917, No. 264–267, p. 24.

van der Haar, A. W.: Data are given showing the condition of purity of certain medicinal substances marketed in Holland since the beginning of the war in Europe.—Pharm. Weekblad, 1917, v. 54, p. 256–259.

van Itallie, E. I., and Woutmon, W. F.: Analytical data are presented showing the purity of chemicals and medicinal products obtained on the market in Holland during the war.—Pharm. Weekblad, 1917, v. 54, p. 301–304.

6. THE PHARMACOPŒIA AS A LEGAL STANDARD.

Anon.: The Secretary of Agriculture does not think it necessary that the status of the new U. S. P. and N. F. be defined by an act of Congress, but holds that the revised editions of these works became effective September 1, 1916, for the purpose of the food and drugs act.—Bull. Pharm., 1917, v. 31, p. 45.

Anon.: A criticism of the Secretary of the Department of Agriculture and others for not introducing a bill into Congress to legalize the ninth edition of the U. S. P.—Am. Perf., 1917, v. 12, p. 5.

Anon.: The National Association of Retail Druggists has adopted a resolution to the effect that the organization use all means at its comm[illegible] in urging the State pharmaceutical associations to take st[illegible] perfect the legalization of the new U. S. P. and N. F. a[illegible]ts legislative committee to endeavor to have Congress

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recognize the new standards by special act.—Apothecary, 1917, v. 29, No. 11, p. 44.

Editorial: Courts in Ohio and Maine have declared that the new revised edition of the Pharmacopœia is not legalized by the statutes of the respective States, and therefore has no authority.—Bull. Pharm., 1917, v. 31, p. 398.

Anon.: Status of the Pharmacopœia under State and Federal laws. A short review of recent rulings.—Proc. Minnesota Pharm. Assoc., 1917, p. 252–254.

Ballard, C. W.: A brief discussion of the relations of the U. S. P. and N. F. to food standards.—J. Am. Pharm. Assoc., 1917, v. 6, p. 792–797.

Beringer, George M.: The readiness with which the public accepts and the drug trade adapts itself to the legal pronouncements of the Pharmacopœia has been shown by the universal acceptance of the official standard for poison tablets of corrosive sublimate.—Am. J. Pharm., 1917, v. 89, p. 350.

Brown, L. A.: The present revisions of the U. S. P. and N. F. are the first editions to appear since the food and drugs act made them legal standards, hence the numerous changes in assay processes, purity rubrics, etc.—Bull. Kentucky Agric. Exper. Sta., 1917, Feb. 15, p. 1.

7. SUPPLEMENT TO THE PHARMACOPŒIA.

Roller, Emil: It is recommended that a supplement be issued after the Pharmacopœia has been in use for one year in order that the deficiencies discovered therein during this time may be corrected.—D.-A. Apoth.-Ztg., 1917, v. 38, p. 155.

Bollinger, C. H.: It seems reasonable to hope that, if experimental work in preparing the working formulas can be pushed, the supplement to the Pharmacopœia can be made a very important one, and the way will be paved for the efficient handling of the next revision proper.—Proc. Minnesota Pharm. Assoc., 1917, p. 171.

8. UNITED STATES PHARMACOPŒIAL CONVENTION.

Beringer, George M.: Since its origin the representation of the Pharmacopœial Convention has been extended to include the various departments of the Federal service, pharmaceutical societies, and schools of pharmacy,the American Chemical Society, the Association of Official Agricultural Chemists, the Association of State and National Food and Dairy Departments, the National Wholesale Druggists' Association, and the National Dental Association. Representation should be extended to include the homeopathic medical schools and the homeopathic medical societies of proper standing.—Am. J. Pharm., 1917, v. 89, p. 574.

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9. GENERAL PRINCIPLES TO BE FOLLOWED IN REVISING THE PHARMACOPŒIA.

Dohme, A. R. L.: The principles underlying the revision of the U. S. P., IX, were not based upon the real purpose of the book, which is a standard for drugs, chemicals, and medicines of the entire country and all classes of its people. The subcommittee on scope was made up mainly of the highly scientific theoretical class, and only a prolonged struggle prevented the ninth revision from being a book of perhaps a hundred pages.—Proc. N. W. D. A., 1917, p. 502.

10. PUBLICATION AND CONTROL.

Editorial: National legislation should be enacted whereby the Federal Government should have control of the publication of the U. S. P. and N. F., as the Federal printing department is thoroughly equipped for the proper handling of these books and the various unnecessary profits as a result of the system of publication under the present let-sublet, et al., arrangement would thereby be eliminated.—Nat. Drug Clerk, 1917, v. 5, p. 140.

Anon.: A reprint of a resolution passed by the Wisconsin Pharmaceutical Association in which the desire is expressed that the future revision of the Pharmacopœia be conducted by the United States Government, with the Convention for the Revision of the U. S. P. as an advisory body.—J. Am. Pharm. Assoc. 1917, v. 6, p. 371.

11. THE PHYSICIAN AND THE PHARMACOPŒIA.

Diner, Jacob: In a discussion of the relation of the physician to the Pharmacopœia, it is stated that, looking at it from the point of view of the therapeutist, chemist, laboratory worker, or general practitioner, the U. S. P. does form and should form a part of the armamentarium of the modern physician and no medical library can be rightfully considered complete without a copy of this work.—Proc. New York Pharm. Assoc. 1917, p. 240–243.

Lascoff, J. Leon: A law should be passed compelling every practicing physician to have a copy of the latest editions of the U. S. P. and N. F. in his or her office, as both works are necessary for correct and intelligent prescribing.—D.-A. Apoth.-Ztg. 1917, v. 38, p. 35.

Satterthwaite, Thomas E.: In a discussion on pharmacopœias, pharmacists, and physicians, the author states that the profession of medicine makes little use of the Pharmacopœia. It is the official guide for the pharmacist, and is in the main reliable, so far as it tells of drugs and how their derivatives are to be obtained; but its scope is entirely too limited for the physician. If he wants guides, he finds them in dispensatories and books on materia medica, or the publications of the manufacturing companies.—J. Am. Pharm. Assoc. 1917, v. 6, p. 611.

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Marquier, Adolph F.: The busy practitioner finds little time for looking over the U. S. P. or N. F., and if the druggist expects to be allowed to compound his prescriptions he must endeavor to bring to the attention of the practitioner from time to time the preparations official in these two publications that are seasonable products.—Proc. New Jersey Pharm. Assoc. 1917, p. 38.

Anon.: The N. A. R. D. has adopted a resolution to the effect that the organization go on record in favor of a more determined demonstration plan to acquaint the members of the medical profession, as well as the pharmacists of the country, with the official U. S. P. and N. F. preparations, this plan to include a recommendation to all medical colleges to teach this branch of medicine in their curriculum.—Apothecary, 1917, v. 29, No. 11, p. 44.

Anon.: In a review of the volume, Epitome of the Pharmacopœia of the United States and the National Formulary with Comments, prepared under the direction of a committee appointed by the Council on Pharmacy and Chemistry of the American Medical Association, it is stated that the pharmacists can not agree with some of the comments therein intended to aid a discriminating selection of therapeutic agents. The book, however, is thought to be valuable as an instrument for acquainting the physician with the preparations of the U. S. P. and N. F.—D.-A. Apoth.-Ztg. 1917, v. 38, p. 48.

Editorial: As a standard of "the drugs that are," the U. S. P. Revision Committee must be guided by returns from the whole United States, not by the opinions of a few research men. That they have been so guided should serve to popularize the work among physicians at large.—Midl. Drug. 1917, v. 51, p. 8.

12. VALUE OF CRITICISM.

Anon.: A review of Hygienic Laboratory Bulletin No. 105, the tenth in the series of Digest of Comments on the Pharmacopœia and the National Formulary, states that no one should attempt writing on the subject of pharmacopœial or National Formulary preparations without consulting these digests and noting what other persons have previously said on the same subject.—Meyer Bros. Drug. 1916, v. 37, p. 243.

13. COMMITTEE OF REVISION.

Dohme, A. R. L.: The U. S. P. Revision Committee, as it exists to-day, is made up of 50 members. Only five of these members are representatives of the manufacturers. Of the 15 members composing the executive committee, only 2 are representatives of the manufacturers. In consequence, the book as it exists to-day, is to a large extent, theoretical rather than practical in nature, and some of the assay processes contained therein, as well as some of

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the products themselves, would not have appeared in their present form if greater consideration and influence had been allowed the manufacturers.—Proc. Am. Drug Mfg. Assoc. 1917, p. 85.

14. NATURE AND PROGRESS OF REVISION.

Beringer, George M.: The U. S. P. is the peer of the various national authorities of this nature and is spoken of abroad as "the autocrat" of pharmacopœias. That the American plan of revision is fundamentally sound has been demonstrated by its withstanding the criticisms of nearly a century, and likewise by the success that has attended the plan and the acknowledged standing of the resulting work.—Am. J. Pharm. 1917, v. 89, p. 572.

Anon.: In the past our pharmacopœias have been prepared principally by professors of pharmacy and chemistry with the cooperation of some physicians. The work of the ninth revision, however, has been performed not only by physicians, teachers, and retail druggists, but also by the scientific departments of leading pharmaceutical and drug and chemical houses. It is felt that the new edition is a great improvement over all other editions in this repect.—Merck's Rep. 1916, v. 25, p. 9–10.

Anon.: There is a general cry for a more expeditious revision of the U. S. Pharmacopœia.—Meyer Bros. Drug. 1917, v. 38, p. 40.

Dohme, A. R. L.: The method of revision of the U. S. P., IX, was faulty and unrepresentative in two ways—namely, the wholesale manufacturing interests were underrepresented, while the medical profession was too largely represented by the therapeutic nihilists; and the actual revision was done by 15 men, styled the executive committee, instead of the revision committee consisting of 50 members.—Proc. N. W. D. A. 1917, p. 501.

Kilmer, Fred B.: It is suggested that the committee of revision which acted for the Ninth Decennial Revision shall, in advance of the pharmacopœial convention, meet and assign certain problems connected with the revision of the Pharmacopœia to such associations and organizations as they can enlist in the work, asking these bodies to cooperate in going over the processes and standards of the ninth revision, giving suggestions for the tenth revision.—Proc. New Jersey Pharm. Assoc. 1917, p. 97; Drug. Circ. 1917, v. 61, p. 584.

Rippetoe, J. R.: It is suggested that there should be created continuous committees to cooperate with the revision committee, as is done by the Official Association of Agricultural Chemists. This association through appointed referees invites members and nonmembers to cooperate in trying out methods of analysis upon standard samples for the purpose of determining the practicability of the methods before making them official.—Drug. Circ. 1917, v. 61, p. 501; J. [illegible] Assoc. 1917, v. 6, p. 463.

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Schlintz, H. A.: It is suggested that a loose-leaf system be adopted by the revision committee. This will allow the publication of any addition as soon as adopted and will allow a perpetual revision. Such a system will allow of changes at any time and will keep the work fully revised at all times. It will eliminate waste and the enormous cost of composing, printing, and binding a new book, as has been the habit.—Proc. Wisconsin Pharm. Assoc. 1917, p. 45.

Scoville, Wilbur L.: Much of the fundamental work of pharmacopœial revision must be done by the schools of pharmacy, especially where problems of research are involved. In the past the revision committees did much research of the briefer type, but they were unable to investigate the more fundamental problems.—Am. Druggist, 1917, v. 65, No. 1, p. 25.

Dezani, Serafino: A review of the new U. S. P. lays great stress on the method of revision.—Giorn. farm. chim. 1917, v. 66, p. 237–242, 268–270.

2. SCOPE.

1. NATURE AND CONTENT OF THE PHARMACOPŒIA.

Fuller, H. C.: As a standard for drugs, the U. S. P., IX, is altogether too limited in its scope. Too much space has been devoted to prescribing standards for chemical reagents, food products, and substances which are purely mechanical in their application to pharmacy, while the vast number of very important drugs and chemicals in daily use in medical practice, both in this country and in the lands to which our drugs are exported, have been left out.—J. Am. Pharm. Assoc. 1917, v. 6, p. 72.

Beringer, George M.: As the legal authority of this Nation, the scope of the Pharmacopœia should be so extended and broadened as to supply proper standards for all medicines of known composition or formula that are commonly used by any recognized school or branch of medicine. In order to fulfill its national obligation its pronouncements should be extended to cover the remedies used by the homeopathic school.—Am. J. Pharm. 1917, v. 89, p. 574.

Bollinger, C. H.: It is suggested that the way has been paved for the proper increase of the scope of the Pharmacopœia, without appreciably increasing its bulk. This consists of the introduction of meritorious substitutes wherever desirable.—Proc. Minnesota Pharm. Assoc. 1917, p. 167–168.

Dohme, A. R. L.: Heretofore and now the makers of the U. S. P. have consisted too largely of men of theoretical knowledge, professors of colleges, and too little of men who are in touch with the everyday occurrences and requirements of the pharmacist and physician in this country. The U. S. P. plays too important a part in the workaday world of pharmacy and medicine of to-day to have such men

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practically determine what should be put in the book and what the standards and methods of preparation should be.—Proc. Am. Drug Mfg. Assoc. 1917, p. 181.

Browder, J. O.: The U. S. P., IX, is a guide to the chemist rather than to the druggist. In fact, the wording, style, nomenclature, tables, and lack of explanation presupposes the general knowledge, in specific cases, and intimate knowledge of the chemistry of drugs and medicines which is beyond the depth of the average druggist.—Meyer Bros. Drug. 1917, v. 38, p. 79.

Brown, L. A.: An enumeration of the changes in the U. S. P., IX, and N. F., IV, presented chiefly in the form of tables.—Bull. Kentucky Agric. Exper. Sta. 1917, Feb. 15, p. 1–39.

Lascoff, J. Leon: The opinion of the majority of the pharmacists is that the Pharmacopœia should be made as simple as possible in order to encourage the pharmacist to manufacture his preparations instead of purchasing them, as is now done in many cases.—Am. Druggist, 1917, v. 65, No. 5, p. 26.

Raubenheimer, Otto: The sanctioning of the use of substitutes in certain cases is an innovation in Pharmacopœia making of the twentieth century. A list of substitutions permitted by the U. S. P., IX, is given.—J. Am. Pharm. Assoc. 1917, v. 6, p. 59–61.

Maben, Thomas: Notes on the U. S. P.,I X, monographs. The lack of attention given the P. I., especially in the case of potent drugs, is criticized.—Chem. & Drug. 1917, v. 89, p. 71–72.

Beringer, George M., jr.: A criticism of some of the pharmacopœial English, with illustrations.—Am. J. Pharm. 1917, v. 89, p. 363–365.

Rippetoe, J. R.: Notes on the chemistry of the U. S. P., IX.—Drug. Circ. 1917, v. 61, p. 501–502.

Wood, Horatio C.: A review of the U. S. P., IX, with special reference to the new remedies contained therein.—Med. Rec. 1917, v. 92, p. 265–267.

Editorial: A review of Hygienic Laboratory Bulletin No. 107 compares the value of the foregoing work with the English publications, Martindale and Westcott's Extra Pharmacopœia, Squire's Companion, and the British Pharmaceutical Codex.—Lancet, 1917, v. 193, p. 356.

Bougault, J.: In a review of the ninth edition of the U. S. P. it is stated that the work is very similar to the French Codex in that the same principles in nomenclature have been observed, the same mode of describing the various items contained therein has been followed, a large number of drugs and medicaments are the same or differ but slightly, and the same care has been exercised in the selection of the tests for identity and purity.—J. pharm. et chim. 1917, v. 15, p. 48–52, 80–86, and 107–118; Farm. Espan. 1917, v. 49, p. 113–114 and 130.

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2. THE PHARMACOPŒIA AS A TEXTBOOK.

Gidley, W. F.: A discussion of the value of the Pharmacopœia and National Formulary as textbooks in the teaching of pharmacognosy.—J. Am. Pharm. Assoc. 1917, v. 6, p. 809–810.

3. A LIMITED MATERIA MEDICA.

Woodruff, W. J.: In each batch of reports contained in journals and periodicals we notice that more and more pages are given to clamorous enunciations of the infallibility of the U. S. P. and the N. F. There is manifest a growing tendency to insist that these works be recognized as the alpha and omega of therapeutics, and that everything outside of them be outlawed.—Proc. Am. Drug. Mfg. Assoc. 1917, p. 33.

Coleman, Warren: The status of drug therapy is in an unsettled state at the present time. Even the action of strychnine as a cardiovascular stimulant is doubted by some. An abstract.—J. Am. M. Assoc. 1917, v. 68, p. 1656.

4. NOMENCLATURE.

Farwell, Oliver Atkins: In a comprehensive discussion of the botanical nomenclature of the U. S. P., IX, it is stated that the authors of this work did not invariably follow either the "Vienna" code or the "American," but either one or the other as it suited their convenience, and in some instances neither.—Drug. Circ. 1917, v. 61, p. 173. For similar comments on the N. F. IV see p. 229–231.

Holmes, E. M.: A criticism of the U. S. P. with reference to the botanical names used therein.—Pharm. J. 1917, v. 33, p. 484.

Friedenberg, O. C., and Davies, W. W.: The opinion is expressed that there has been an indiscreet use of synonyms in the N. F., IV, in some cases which makes the book appear very inconsistent in the eyes of the readers, and thereby will tend to weaken its legal status when it has been accepted by the Government.—J. Am. Pharm. Assoc. 1917, v. 6, p. 481–483.

Beringer, George M.: The custom of physicians in prescription writing not infrequently determines changes in pharmacopœial titles. The changing of the title Fluidextractum Rhamni Purshianæ to Fluidextractum Cascaræ Sagradæ is an example of this kind.—Am. J. Pharm. 1917, v. 89, p. 14.

Brown, L. A.: Both the U. S. P., IX, and N. F., IV, have adopted official abbreviations for the Latin titles of drugs and preparations, as an aid in the writing of prescriptions, and which should be of great assistance to physicians in prescribing drugs possessing long and cumbersome titles. It will also be of service in tending to prevent errors in filling prescriptions calling for ingredients that are often abbreviated in an ambiguous manner.—Bull. Kentucky Agric. Exper. Sta. 1917, Feb. 15, p. 37.

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Rippetoe, J. R.: The abbreviation "Fldext." is awkward to write and not pleasing to the eye. "Flext." is much better.—Drug. Circ. 1917, v. 61, p. 501; J. Am. Pharm. Assoc. 1917, v. 6, p. 464.

Roller, Emil: The popular names of preparations are not always recognized by the U. S. P. and the N. F. If they were, Oleum Camphoratum and Tinctura Saponis Mollis would be termed Linimentum Camphoræ, etc.—D.-A. Apoth.-Ztg. 1917, v. 38, p. 31.

Patterson, Austin M., and Curran, Carleton E.: An account, with examples, of the principles observed by the authors in their work of indexing organic compounds for the Decennial Index of Chemical Abstracts.—J. Am. Chem. Soc. 1917, v. 39, p. 1623–1638.

Thomas, Arthur W.: A plea for reform in the nomenclature used in colloid chemistry.—Science, 1917, v. 47, p. 10–14.

Fajans, K.: A paper pointing out the chaotic state of the radioactive nomenclature. It is suggested that, pending an international revision of the nomenclature, the names first used should be employed.—Ztscher. Elektrochem. 1917, v. 23, p. 250–257, through J. Chem. Soc. Lond. 1917, v. 112, part 2, p. 523.

Krais, P.: The author proposes using the Greek "euodia" as a root word in naming perfumes—e. g., to call the aldehydes odogens, as they contain the odophore group (CHO) to which the auxodic groups (as OCH_3) or miodic groups (as OH) unite.—Chem. Zentralbl. 1916, v. I, p. 1208, through Chem. Abstr. 1917, v. 11, p. 1723.

Anon.: A book review calls attention to a new German-English Dictionary for Chemists by Austin M. Patterson.—J. Am. Chem. Soc. 1917, v. 39, p. 1296.

5. DOSES.

Anon.: A book review of The Stearns Dose Book states that the new work has been revised in accordance with the U. S. P., IX, and the N. F., IV, and that it gives the dosage of over 3,300 drugs and preparations. It also contains tables of solubilities, poisons, and antidotes, and general rules outlining the more common incompatibilities.—Am. Druggist, 1917, v. 65, No. 12, p. 78; Western Druggist (The), 1917, v. 39, No. 12, p. 36.

6. ANTIDOTES.

Wilms, J. H.: Observations on the value of calcium sulphide as a chemical and clinical antidote for mercuric chloride poisoning. The article includes experimental data and case reports.—J. Lab. & Clin. Med. 1917, v. 2, p. 445–458.

Fantus, B., and Hyatt, E. G.: A report of researches to determine the value of phosphite and hypophosphite combinations as antidotes for mercuric chloride poisoning.—J. Lab. & Clin. Med. 1917, v. [illegible]–818.

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Linhart, G. A.: A method for the preparation of pure sodium phosphite for use as an antidote for mercuric chloride poisoning is described in detail.—J. Lab. & Clin. Med. 1916–1917, v. 2, p. 722–725.

Gates, Frederick L., and Meltzer, S. J.: A report on the antagonistic effect of magnesium sulphate against fatal doses of sodium oxalate.—J. Pharmacol. 1917, v. 9, p. 353–354.

Kleiner, I. S., and Meltzer, S. J.: A report on the reduction of the toxicity of strychnine by the administration of large quantities of indifferent fluids.—J. Pharmacol. 1916, v. 9, p. 359.

Shelton, H. P.: A note on the value of apomorphine as an antidote for strychnine poisoning.—Therap. Gaz. 1917, v. 41, p. 456.

Withers, W. A., and Carruth, Frank E.: A report on iron as an antidote for cottonseed meal injury.—J. Biol. Chem. 1917, v. 32, p. 245–257.

7. WEIGHTS AND MEASURES.

Stratton, S. W.: Classified information concerning units of weight and measure, their definitions and tables of equivalents.—Circ. Bur. Stand. 1917, No. 47, p. 1–68.

Ingalls, Walter B.: A paper discussing the question, "Shall Great Britain and America adopt the metric system?"—J. Roy. Soc. Arts, 1917, v. 65, p. 604–610.

King, George C.: A short discussion of how to adopt the metric system.—Pract. Drug. 1917, v. 35, No. 7, p. 28.

Miller, Adolph W.: Report of the special committee of the Northwestern Druggists' Association for the cooperation with the other national bodies in promoting an educational campaign having for its object the ultimate adoption of the metric system as the official standard of weights and measures in this country.—Western Druggist (The), 1917, v. 39, p. 271–274.

Editorial: Many scientific and professional bodies have indorsed the metric system, but the most emphatic step yet taken in its favor is the employment of it to the complete exclusion of the apothecaries' system in the late revision of the U. S. P. and N. F. The adoption of the term mil in the U. S. P. in preference to c. c. is another step toward the permanent and exclusive use of the metric system.—Midl. Drug. 1917, v. 51, p. 134.

Editorial: The U. S. P. has used the metric system to the exclusion of all others through two revisions, and druggists find it very much simpler than either the avoirdupois or apothecaries' weights or the old-fashioned wine measures in general use, and have no desire to change back again to these old units. The same kind of an experience would be had in all other callings should it be required of our people.—Midl. Drug. 1917, v. 51, p. 168.

England, J. W.: A discussion of the metric system in relation to industrial preparedness.—J. Am. Pharm. Assoc. 1917, v. 6, p. 73–74.

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Arny, H. V.: A lecture on the application of the metric system in everyday life.—J. Am. Pharm. Assoc. 1917, v. 6, p. 254–257.

Anon.: At the one hundred and seventieth meeting of the American Association for the Advancement of Science, held at Columbia University December 27, the American Metric Association was formed.—Am. Perf. 1917, v. 11, p. 317.

Anon.: A book review calls attention to a pamphlet by D. Charles O'Connor entitled, "The Metric System for Druggists."—Drug. Circ. 1917, v. 61, p. 209.

Anon.: The American Institute of Weights and Measures has been organized in New York City for the purpose of combating the efforts being made to further the adoption of the metric system.—Am. Perf. 1917, v. 12, p. 6.

Dobbin, Leonard: Comments on the use of milliliter in place of cubic centimeter in the Ph. Brit., and on some of the British abbreviations for measures of the metric system.—Pharm. J. 1917, v. 98, p. 234–235.

Brown, L. A.: Owing to a slight inaccuracy in the value of a cubic centimeter, as used, the committee of revision decided to use the term mil.—Bull. Kentucky Agric. Exper. Sta. 1917, Feb. 15, p. 2.

Guichard, M.: Attention is drawn to errors which may be caused in weighing through inequalities of temperature between the two sides of the balance. Data obtained in the measurement of these errors under different conditions are presented.—Bull. soc. chim. France, 1917, v. 21, p. 233–235.

Blount, B.: Some observations on the limitations of the balance. Six of the best balances were examined by three observers at two different places over a four-months' period, and gave variations of 0.4 to 1.6 milligrams.—J. Chem. Soc. Lond. 1917, v. 111, p. 1035–1039.

Guichard, Marcel: A description of a method for weighing vacuum tubes.—Bull. soc. chim. France, 1917, v. 21, p. 235–237.

Weigle, George J.: Inspections made during the year 1915 revealed the fact that 26.3 per cent of the glass graduates used in the drug stores of Wisconsin were inaccurate, the inaccuracies being due to improper calibration on the part of the manufacturer. During this same period, 34.2 per cent of the prescription weights tested were found to be inaccurate. The latter condition is due not only to the manufacturer, but in a very large degree to the carelessness of the druggist in cleaning the weights.—Pharm. Era, 1917, v. 50, p. 85–86.

Arny, H. V.: A short article calling attention to the variation in the capacity of the ordinary teaspoon.—J. Am. Pharm. Assoc. 1917, v. 6, p. 1056–1057.

Delage, Yves: A description of a new system of pharmacological equivalents and therapeutic units, and their application to the writing of prescriptions.—Compt. rend. acad. sc. 1917, v. 164, p. 469–472.

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Anon.: A review of the provisions of the weights and measures act passed by Newfoundland in 1916.—Com. Rep. 1917, No. 23, p. 354.

8. OBJECTS AND USES.

Lascoff, J. Leon: Not only should the U. S. P. and N. F. be on the shelves of every pharmacist, but, as a ready reference guide, both should be in the possession of every practicing physician as well.—Am. Druggist, 1917, v. 65, No. 5, p. 25.

9. ADDITIONS AND DELETIONS.

Beringer, George M.: A decision whether an article or formula shall be admitted to, retained in, or deleted from the official list of titles is presumed to be based upon the medical practice of the time and the general or extended use of such medicament. It seems, however, that the decisions on such matters were largely based on personal practice and preferences.—Am. J. Pharm. 1917, v. 89, p. 349.

Brown, L. A.: Of those articles official in the text of the U. S. P., VIII, 243 have been dismissed, while 67 new ones have been introduced into the U. S. P. IX.—Bull. Kentucky Agric. Exper. Sta. 1917, Feb. 15, p. 2.

Raubenheimer, Otto: The addition of chemicals to the U. S. P., as well as deletions therefrom, have been governed by two basic principles formulated by the subcommittee on scope—namely, therapeutic usefulness and pharmaceutic necessity.—J. Am. Pharm. Assoc. 1917, v. 6, p. 525.

Dohme, A. R. L.: Too many of the drugs which are still largely used and are giving results to physicians were omitted from the U. S. P., IX. The result is the creation of an increasing number of tentative standards of drugs by the Bureau of Chemistry.—Proc. N. W. D. A. 1917, p. 502.

Diekman, George C.: The deletion of elixir of iron, quinine, and strychnine phosphates from the Pharmacopœia has been severely criticized. Pharmacists have not generally accepted the reason assigned for the deletion of this preparation—namely, that a satisfactory formula could not be devised.—Proc. New York Pharm. Assoc. 1917, p. 96.

Thompson, Leon A.: The deletion of the saturation tables contained in the U. S. P., VIII, is criticized on the ground that they were useful to many pharmacists who were accustomed to prepare some of the common and uncommon chemicals.—Nat. Drug. 1917, v. 47, No. 4, p. 136.

10. PURITY AND STRENGTH.

Anon.: Lack of quality in drugs is the one great factor that is causing pharmacy and medicine irreparable harm, and it is time that the eyes of all druggists were open to the mischief that is being and has been done.—N. A. R. D. J. 1917, v. 23, p. 684.

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Scoville, W. L.: Some of the samples of zinc salts examined showed a large excess of metallic impurities.—J. Am. Pharm. Assoc. 1917, v. 6, p. 415.

11. ATOMIC WEIGHTS.

Anon.: A table of the international atomic weights for 1917.—J. chim. phys. 1917, v. 15, p. 96; Analyst, 1917, v. 42, p. 1.

Baxter, Gregory P.: The twenty-fourth annual report of the committee on atomic weights. Determinations published during 1916.—J. Am. Chem. Soc. 1917, v. 39, p. 333–341.

Clarke, F. W.: On account of the difficulties of correspondence between six members, the international committee on atomic weights has decided to make no full report for 1918. There are, therefore, no changes in the atomic weight table for 1917.—J. Am. Chem. Soc. 1917, v. 39, p. 2517–2518.

Bilecki, Alois: A paper dealing with fundamental atomic weights. Exceptions to the rule that atomic weights are multiples of the number 0.31 are pointed out.—Ztschr. anorg. Chem. 1916, v. 98, p. 86–96, through J. Chem. Soc. Lond. 1917, v. 112, part 2, p. 197.

Chwolson, O. D.: A theoretical paper in which the author considers how near the atomic weights of the elements approach to some multiple of 4 (atomic weight of helium).—J. Chem. Soc. Lond. 1917, v. 112, part 2, p. 27, from Bull. Acad. Imp. Sci. Petrograd, 1915, p. 1841–1852.

Stewart, John Q.: A discussion of the relation of atomic weights to atomic numbers, and a suggested structure of atomic nuclei.—Science, 1917, v. 46, p. 568–569.

Durrant, Reginald G.: A theoretical paper discussing the numerical relation of atomic weights to atomic numbers.—J. Am. Chem. Soc. 1917, v. 39, p. 621–626.

Renard, T.: It is proposed that the rounded-off values of the atomic weights given by Guye, which in almost all cases are within the limits of possible error of determination, should be used in all general chemical calculations.—J. chim. phys. 1917, v. 15, p. 540–548.

Guye, Ph. A., and Moles, E.: A further consideration of the errors involved in the accurate determination of atomic weights, in which attention is directed to surface actions as a source of error in weighing.—J. chim. phys. 1917, v. 15, p. 360–404 and 405–432.

Guichard, Marcel: A general criticism of the methods used for determining atomic weights. Three conditions for such methods are stated.—Bull. soc. chim. France, 1917, v. 21, p. 238–241.

Kanolt, C. W.: A note on the determination of atomic weights by means of X-rays.—Science, 1917, v. 47, p. 123–124.

Moles, E.: A review of the work done on the revision of atomic weights during the year 1916.—J. chim. phys. 1917, v. 15, p. 433–469.

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Stähler, Arthur, and Tesch, Bruno: A new determination of the atomic weight of tellurium gave the value 127.513 ± 0.003.—Ztschr. anorg. Chem. 1916, v. 98, p. 1–26, through J. Chem. Soc. Lond. 1917, v. 112, part 2, p. 202.

Reiman, Clarence K.: Revision of the atomic weight of bromine. Determination of the normal density of hydrogen bromide gas.—J. chim. phys. 1917, v. 15, p. 293–333; see also Wallace J. Murray, J. chim. phys. 1915, v. 15, p. 334–359.

Guye, P. A.: Three sources of error, showing the necessity of making a new correction in the atomic weight of silver, are pointed out.—J. chim. phys. 1917, v. 15, p. 549–560.

Moles, E.: Further evidence in support of Guye's view, that the revision of the atomic weights of carbon and sulphur proposed for 1916 by the international committee are premature and not justified, are presented.—J. chim. phys. 1917, v. 15, p. 51–59.

Baxter, G. P., and Grose, M. R.: A report of the revision of the atomic weight of zinc by the electrolytic determination of zinc in zinc bromide. The number found was 65.388.—Chem. News, 1917, v. 115, p. 6–8.

Honigschmid, Otto, and Horovitz, Stefanie: A revision of the atomic weight of thorium based on the analysis of thorium bromide.—Chem. Abstr. 1917, v. 11, p. 1581.

Sears, George W.: A study of tantalum chloride with reference to its use in the determination of the atomic weight of tantalum.—J. Am. Chem. Soc. 1917, v. 39, p. 1582–1587.

Stewart, O. J., and James, C.: From 17 determinations made of the ratio $SaCl_3$:3Ag, using the pure materials, the atomic weight of samarium was found to be 150.44.—J. Am. Chem. Soc. 1917, v. 39, p. 2605–2613.

Venable, F. P., and Bell, J. M.: A report of researches dealing with the atomic weight of zirconium.—J. Am. Chem. Soc. 1917, v. 39, p. 1598–1608.

3. NONPHARMACOPŒIAL STANDARDS.

1. NATIONAL FORMULARY.

Brown, L. A.: The National Formulary contains drugs and formulas, more or less extensively used by the medical profession, but which are not of sufficient importance to be included in the U. S. P. The N. F. is recognized by the Federal and State food and drugs acts as a legal standard; therefore, in the revision, it was necessary to establish standards and provide assay methods in a great many instances.—Bull. Kentucky Agric. Exper. Sta. 1917, Feb. 15, p. 23.

Editorial: The N. F. is now practically a secondary list for the U. S. P., including such drugs as aletris, asclepias, castanea, conium,

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dulcamara, leptandra, quinidine, scoparius, and xanthoxylum—all drugs that "won't down" in the opinion of thousands of estimable medical practitioners. The N. F. is no longer a mere list of elixirs, etc., designed to imitate more or less permanent proprietary products. Within its bounds the new N. F. is just as scientific and discriminating as is the new U. S. P.—Midl. Drug. 1917, v. 51, p. 8.

Hemm, Francis: Notes on the history of the N. F. revision and on some of the new preparations in the N. F., IV.—Proc. Missouri Pharm. Assoc. 1917, p. 128–135.

Editorial: Since the printing of the fourth revision of the National Formulary a number of errors have been reported. These have been corrected in a later printing. Ten of these corrections concern changes in formulas; 11 are changes in titles; 29 are changes in synonyms; 20 are changes in abbreviations; and 3 are miscellaneous changes.—Am. Druggist, 1917, v. 65, No. 12, p. 24.

Fuller, H. C.: From a study of the new edition the author concludes that the N. F., IV, is a more tolerant standard than the U. S. P., IX.—J. Am. Pharm. Assoc. 1917, v. 6, p. 69.

Rusby, H. H.: As the profits from the publication of the N. F. can not go into the general treasury of the A. Ph. A., but must be used by the committee on the N. F., there can no longer be any excuse for the continuation of this publication by the association. It ought to be published by the U. S. Pharmacopœia Revision Committee.—Pract. Drug. 1917, v. 35, No. 3, p. 28.

Searcy, J. A.: A comparison of the relative values of the National Formulary and Pharmacopœia to the pharmacist.—Proc. Kansas Pharm. Assoc. 1917, p. 74–75.

Smith, F. A. Upshur: For some time the National Formulary has been winning its way into favor, and a tendency has developed to eliminate, to a large degree, from the Pharmacopœia compound medicines of an extemporaneous character. In this way the National Formulary has become the repository for the formulas of many such medicines.—Proc. Minnesota Pharm. Assoc. 1917, p. 172–174.

O'Connor, D. Charles: A short digest of the N. F., IV.—Spatula, 1917, v. 23, p. 539–544.

2. RECIPE BOOK.

Gathercoal, E. N.: In a discussion of the Am. Pharm. Assoc. Recipe Book, Dr. Bernard Fantus states that you can vouch for the ingredients of any preparation, but that you can not vouch for the therapeutic or curative effect. He therefore suggests that it would be advisable to exclude from the Recipe Book all titles suggesting medicinal use.—Midl. Drug. 1917, v. 51, p. 4.

Hoffman, C. Elbert: In a thesis on the methods of preparation and means of dispensing topical applications for the treatment of diseases

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of the eye, a number of formulas for eye remedies is given.—Am. J. Pharm. 1917, v. 89, p. 296–306.

Hoffman, George N.: Practical formulas for the preparation of a number of adhesives are given in detail.—Drug. Circ. 1917, v. 61, p. 184.

Anon.: A list of formulas for the A. Ph. A. book of formulas.—D.-A. Apoth.-Ztg. 1917, v. 38, p. 19.

Anon.: A list of formulas proposed for the A. Ph. A. Recipe Book.—J. Am. Pharm. Assoc. 1917, v. 6, p. 78–82, 194–197, 298–301, 393–396, 486–489, 563–566, 643–646, 729–732, 823–826.

Anon.: A number of formulas for the preparation of cough candies is given.—Am. Druggist, 1917, v. 65, No. 1, p. 40.

Thomas, George E., and Alexander, A.: A discussion of a number of formulas for the manufacture of modern dentrifices.—Am. Perf. 1917, v. 12, p. 7–8, 43.

Anon.: A list of formulas for a variety of preparations.—Canadian Pharm. J. 1917, v. 50, p. 250, 278, 358, 406, 505, 544.

Anon.: A book review of *Pharmaceutical Formulas* by Peter MacEwan states that many new formulas are incorporated in the new edition, especially of preparations which are "admitted and approved remedies" in the sense of the medicine stamp act of Great Britain.—Am. Perf. 1917, v. 12, p. 206.

Anon.: A list of formulas for a variety of preparations.—Am. Druggist, 1917, v. 65, No. 1, p. 38–39; No. 2, p. 39–40; No. 3, p. 38–40; No. 4, p. 39–40; No. 5, p. 39; No. 6, p. 38–39; No. 7, p. 32; No. 9 p. 37; N. 11, p. 40–41; No. 12, p. 37–38.

3. NEW AND NONOFFICIAL REMEDIES.

Anon.: In a review of a publication by the American Medical Association entitled "New and Nonofficial Remedies, 1917," it is stated that every physician and pharmacist who desires to keep abreast of the times should have a copy of this annual, for in it they will find such recent information as that relating to the preparation of acetylsalicylic acid and the revised Carrel-Dakin solution, as well as many other useful suggestions.—Pharm. Era, 1917, v. 50, p. 156.

Editorial: The American Medical Association considers the newer proprietary preparations of such importance that it prints a new and revised edition of New and Nonofficial Remedies every year, thus producing the most critical and scientific drug standard in existence. It makes no claim to be a therapeutic standard, since the drugs incorporated are simply on a scientific basis and require clinical trial to demonstrate their value. It is surprising how many of them make good and are, later, incorporated in the Pharmacopœia.—Midl. Drug. 1917, v. 51, p. 7.

Thum, John K.: A book review of New and Nonofficial Remedies, 1917, states that for the seeker after proprietary medicinal knowledge

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this book is a reliable and ready source of information. The present volume, like its predecessors, is right up to date.—Am. J. Pharm. 1917, v. 89, p. 375.

SYNTHETICS.

Anon.: A book review calls attention to a volume by C. Craveri on the manufacture of organic products used in medicine and introduced during the period 1880–1915.—Giorn. farm. chim. 1917, v. 66, p. 298.

Anon.: An editorial calling attention to the probabilities of the development of biochemical processes for the preparation of synthetic chemicals.—J. Am. M. Assoc. 1917, v. 69, p. 735.

Anon.: The Council on Pharmacy and Chemistry of the American Medical Association announces that they propose to make a study of the quality of American-made synthetics. The council feels that inasmuch as the manufacture of some of the synthetic drugs is to some extent experimental in this country, it is due physicians and the public that they be given the protection which will come from the proposed investigation of the market supply.—Oil, Paint & Drug Rep. 1917, v. 92, No. 13, p. 16; Am. J. Pharm. 1917, v. 89, p. 588.

Anon.: A book review of a volume by Henry V. Arny entitled, *Principles of Pharmacy*, refers to the book as an ideal text for the student in pharmacy and a decided aid to the pharmaceutical chemist, especially to those who desire to more completely study the recent synthetic products and the great advance made in synthetic chemistry.—Midl. Drug. 1917, v. 51, p. 361.

Eder, R.: An address giving an historical survey of the principal synthetic drugs up to salvarsan. A bibliography is also given.—Schweiz. Apoth.-Ztg. 1917, v. 55, p. 493–498, 505–509 and 526–531.

Lanski, Jacob: A plea for the exercise of common sense in the use of synthetics.—J. Am. M. Assoc. 1917, v. 69, p. 665.

Luders, R.: Descriptions of the synthetic medicinal products which appeared in 1915.—Chem. Zentralbl. 1916, v. 87, p. 158 through Chem. Abstr. 1917, v. 11, p. 1879.

Queeny, John F.: An account of the coal-tar industry illustrated with a drawing of the coal-tar genealogical tree.—Pharm. Era, 1917, v. 50, p. 5–8.

NEW REMEDIES.

Lausanne, S. Rabow: A review of the therapeutic novelties made known in 1915, including the specialities and proprietary remedies. The trade name, curative principle, and name of manufacturer are given in most cases. A bibliography of 174 references is appended.—Chem.-Ztg. 1916, v. 40, p. 145–147, 167–169, 183–185 through Chem. Abstr. 1917, v. 11, p. 1253.

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Mannich, C.: A review of new pharmaceutical specialties and patent medicines.—Ztschr. angew. Chem. 1916, v. 29, p. 285–288 through Chem. Abstr. 1917, v. 11, p. 685.

Mencière, L.: A number of formulas of remedies for use in the treatment of wounds are given.—J. pharm. et chim. 1917, v. 15, p. 52–53.

Messner, J.: A quarterly report on new remedies. Principally a bibliographic review.—Ztschr. angew. Chem. 1916, v. 29, p. 257–261 through Chem. Abstr. 1917, v. 11, p. 684.

Anon.: A list of new proprietary remedies.—Am. Druggist, 1917, v. 65, No. 1, p. 37–38; No. 2, p. 38–39; No. 3, p. 37–38; No. 4, p. 38; No. 6, p. 37–38; No. 7, p. 21; No. 8, p. 32; No. 9, p. 32; No. 11, p. 39; No. 12, p. 32.

Anon.: A descriptive list of new remedies introduced in 1916.—Pharm. Era, 1917, v. 50, p. 141, 155 and 203.

Anon.: Short descriptions of some new proprietary remedies.—Pharm. Ztg. 1917, v. 62, p. 105 through Ztschr. angew. Chem. 1917, v. 30, part 1, p. 173.

Anon.: Short descriptions of a number of recently introduced remedies.—Pharm. Zentralh. 1917, v. 58, p. 116–118 through Ztschr. angew. Chem. 1917, v. 30, part 1, p. 174.

Anon.: A list of new remedies introduced during 1915.—Merck's Rep. 1916, v. 25, p. 25–26.

Anon.: A descriptive list of new remedies introduced during the year 1916.—Merck's Rep. 1917, v. 26, p. 16–17.

Anon.: A list of European proprietary remedies recently placed upon the market.—Drug. Circ. 1917, v. 61, p. 88 and 152.

Anon.: A review of a volume by H. Bocquillon-Limousin entitled *Formulaire des Mèdicaments nouveaux pour 1917*.—Boll. chim.-farm. 1917, v. 56, p. 331.

Fleissig: A book review calls attention to a 402-page volume by E. Merck entitled *Medizinische Spezialpräparate*—Schweiz. Apoth.-Ztg. 1917, v. 55, p. 38.

PATENTS AND TRADE-MARKS.

Anon.: The trading with the enemy act, which has recently become a law, throws open to the public all patents, trade-marks, prints, labels, or copyrights belonging to an enemy or an ally of enemy subject; but provision is made by which such use shall be accounted for to the owner of such patent, etc., through a court proceeding, the adjustment to be made at the conclusion of the war.—Oil, Paint & Drug Rep. 1917, v. 92, No. 15, p. 18.

Anon.: About 20,000 German patents and copyrights controlling medical discoveries are released for American manufacture by the United States Government. Licenses will be issued to American

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manufacturers and to such firms as have the necessary facilities for production.—Western Druggist (The), 1917, v. 39, p. 268.

Anon.: An editorial discussing patent medicines states that when the Patent Office is used for an extension of the nostrum business, founded on the abuse of patent and trade-mark laws, it becomes a menace to the public health.—J. Am. M. Assoc. 1917, v. 68, p. 1914–1915.

England, J. W.: In a discussion of the product protection of chemical compounds, the author states that the determination of patent questions is a technical and scientific matter, and the greatest obstacle in the way of patent reform is the ignorance of the legal fraternity, including both the bench and bar, in the sciences of medicine, pharmacy, and chemistry and the arts, or technical applications of the same.—J. Am. Pharm. Assoc. 1917, v. 6, p. 120–122.

Woodruff, Charles M.: In a discussion of the relations of the patent law to chemical and medical discoveries, the author states that, in the name of equal right and common justice, product patents should not be denied inventors in the field of chemistry, medicine, pharmacy, and surgery.—J. Am. Pharm. Assoc. 1917, v. 6, p. 475–480.

Editorial: An argument against the patenting of the process of manufacture alone, and in favor of a product patent.—Bull. Pharm. 1917, v. 31, p. 137.

Stewart, F. E.: A discussion of the Paige bill, relating to a proposed revision of the patent law.—J. Am. Pharm. Assoc. 1917, v. 6, p. 122–130.

Stewart, F. W.: A report of the American Pharmaceutical Association Committee on Patent Law Revision.—J. Am. Pharm. Assoc. 1917, v. 6, p. 574–577.

Winters, F. V.: A discussion of the value of trade-mark registration.—Pract. Drug. 1917, v. 35, No. 1, p. 42.

Anon.: The aspirin situation from an advertising viewpoint. A short discussion.—Am. Druggist, 1917, v. 65, No. 4, p. 58.

Anon.: Changes in French laws governing patents and trade-marks as they apply to the chemical and pharmaceutical industries.—Bull. Assoc. gén. Syn. pharm. France, 1917, v. 20.

Anon.: Illustrated descriptions of new patents and trade-marks of pharmaceutical interest.—Spatula (The), 1917, v. 23 and 24.

Anon.: A list of trade names registered at the International Bureau for the Protection of Proprietaries during the year 1916.—Schweiz. Apoth.-Ztg. 1916, v. 54, p. 211–212.

Anon.: For descriptions of English patents, see J. Soc. Chem. Ind. 1917, v. 36.

For Swiss patents and trade-marks, see Schweiz. Apoth.-Ztg. 1917, v. 55

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CHEMOTHERAPY.

Andreev, N.: A paper dealing with the processes of adsorption in their relation to chemotherapeutics and immunity.—J. Russ. Phys. Chem. Soc. 1916, v. 48, p. 222–251, through J. Chem. Soc. Lond. 1917, v. 112, part 1, p. 183.

Akatsu, Seinai, and Noguchi, Hideyo: A study of the drug-fastness of spirochaetes to arsenic, mercury, and iodine compounds in vitro.—J. Exper. M. 1917, v. 25, p. 349–362; see also Seinai Akatsu, p. 363–373.

Belin: Notes on a new form of chemotherapy. The method consists of the injection (subcutaneous, intramuscular, or intravenous) of some oxidizing substance. Potassium permanganate was employed in the experiments.—Compt. rend. acad. sc. 1917, v. 165, p. 1074–1076.

Fourneau, E., and Vulquin: A report of researches on the passage of alkaloids and hypnotics in aqueous solutions through lipoid membranes.—Bull. soc. chim. France, 1917, v. 23, p. 201–206.

Lami, Pio: A discussion dealing with the field of pharmacotherapy and the theory of Langley.—Boll. chim.-farm. 1917, v. 56, p. 457–466.

Pyman, F. L.: An abstract of a lecture on the relation of chemical constitution to physiological action.—Lancet, 1917, v. 193, p. 924–925.

Schamberg, J. F., et al.: A study of the chemotherapeutic properties of various organic compounds of mercury.—Am. J. Syphilis, 1917, v. 1, p. 1–41.

Tarugi, N., and Bracci, C.: A discussion of the influence of catalysers in therapeutics.—Boll. chim.-farm. 1917, v. 56, p. 537–540, 557–564.

Gautier, Armand: Notes on the activation of the curative properties of quinine and mercury by means of organometallic compounds of arsenic.—Compt. rend. acad. sc. 1917, v. 164, p. 590–593.

Solis-Cohen, S., et al.: Studies on the protective and curative value of urea hydrochloride, ethylhydrocuprein, and other cinchona derivatives in experimental pneumococcus infections.—J. Infect. Dis. 1917, v. 20, p. 313–332.

Kolmer, John A., et al.: A study of the influence of quinine and urea hydrochloride, ethylhydrocuprein, and other cinchona derivatives on leukocytosis and phagocytosis of pneumococci in vitro.—J. Infect. Dis. 1917, v. 20, p. 333–343.

Frouin, Albert, and Grégoire, R.: A report of results obtained with metallic tin and tin oxide in the treatment of staphlococcic infections.—Compt. rend. acad. sc. 1917, v. 164, p. 794–797.

Kolmer, John A., et al.: Descriptions of methods for determining the trypanocidal activity of substances in vitro and their relation to the chemotherapy of experimental trypanosomiasis.—J. Infect. Dis. 1917 v. 20, p. 10–27.

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Kolmer, John A., et al.: Methods for determining the bactericidal action of substances in vitro and their relation to the chemotherapy of bacterial infections.—J. Infect. Dis. 1917, v. 20, p. 293–312.

Izar, Guido: Researches on the chemotherapy of Malta fever. The effects of ethylhydrocuprein and isopropylhydrocuprein and isoamylhydrocuprein were studied.—Chem. Abstr. 1917, v. 11, p. 503.

Proescher, F., Seil, H. A., and Stillians, A. W.: On the action of vanadium, with particular reference to the treatment of syphilis.—Am. J. Syphilis, 1917, v. 1, p. 347; J. Am. M. Assoc. 1917, v. 68, p. 1661.

Lewis, Paul A.: Observations bearing on the possibility of developing an experimental chemotherapy of tuberculosis.—J. H. Hosp. Bull. 1917, v. 28, p. 120–125.

Lewis, Paul A.: A lecture on the development of chemotherapy in the treatment of tuberculosis.—Am. J. M. Sc. 1917, v. 153, p. 625–640.

Lewis, P. A.: The accomplishments of the Henry Phipps Institute with respect to the chemotherapy of tuberculosis.—Am. J. M. Sc. 1917, v. 153, p. 625; J. Am. M. Assoc. 1917, v. 68, p. 1660.

Countess v. Linden: An experimental study of the chemotherapy of tuberculosis with copper and methylene blue salts.—Chem. Abstr. 1917, v. 11, p. 501.

Burzi, C.: From experiments it is concluded that copper lecithinate exerts no curative action in cutaneous tuberculosis, nor does it cause any perceptible effect in cancer of the skin.—Chem. Abstr. 1917, v. 11, p. 502.

Takeoka, Minokichi: Studies in the treatment of experimental tuberculosis in guinea pigs and rabbits by taurin, alone, and in combination with gold chloride and sodium oleate.—J. Infect. Dis. 1917, v. 20, p. 442–456.

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Abbe, Robert: A discussion of the proper place for radium in the treatment of cancer.—Med. Rec. 1917, v. 91, p. 931–932.

Barker, H. H.: A discourse on radioactivity and some advances in physical science.—Chem. Abstr. 1917, v. 11, p. 3172.

Berthoud, A.: A review of the progress in radiochemistry for the year 1916.—J. chim. phys. 1917, v. 15, p. 93–95.

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Duncan, Rex: A discussion of radium, its chemical, physical, and therapeutic properties.—Proc. California Pharm. Assoc. 1917, p. 32–40.

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Furber, F. B.: A report on methods for the determination of radioactivity.—J. Assoc. Off. Agric. Chem. 1916, v. 2, p. 116–119.

Happel, H. E.: A lecture on the radium emanation waters.—Med. Rec. 1917, v. 91, p. 843; J. Am. M. Assoc. 1917, v. 68, p. 1665.

Heise, George W.: Data showing the constancy in the radioactivity of certain Philippine waters.—Philippine J. Sc. 1917, v. 12A, p. 309–311.

Moran, J.: A study of the release of radium emanation from water at different temperatures by the bubbling method.—Chem. Abstr. 1917, v. 11, p. 1084.

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Samuel, E. C.: A general article dealing with radium therapy.—Southern Med. J. 1917, v. 10, p. 490–494.

Walsh, J. W. T.: A discussion of the theory of decay in radioactive luminous compounds.—Proc. Roy. Soc. 1917, v. 93A, p. 550–564.

Pratt, L. S.: A report on the measurements of radioactivity of a specimen of allanite from Maine.—Trans. Am. Inst. Mining Eng. 1917, v. 60, p. 935 through Chem. Abstr. 1918, v. 12, p. 2157.

Hahn, P. D.: Descriptions of six radioactive minerals of South Africa.—South African J. Sci. 1916, v. 12, p. 449–452 through Chem. Abstr. 1917, v. 11, p. 11.

Lachs, H.: Notes on the radioactive decomposition products of potassium and rubidium.—Chem. Abstr. 1917, v. 11, p. 1360.

Saubermann, S.: U. S. patent No. 1,236,213. A process for charging aqueous liquids with radium emanations.—Chem. Abstr, 1917, v. 11, p. 2639.

Baker, T. T.: British patent No. 10,151. Radioactive preparations are made by spraying fused sodium chloride with an aqueous solution of a radioactive material and then dried.—Chem. Abstr. 1917, v. 11, p. 117.

Holding, Arthur F., and Long, William B.: The truth about radioactive therapy in the treatment of malignant growths.—J. Am. M. Assoc. 1917, v. 69, p. 982–984.

Ewing, James: A review of radium therapy in the treatment of cancer.—J. Am. M. Assoc. 1917, v. 68, p. 1238–1247.

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Fleming, Fred: Notes on the care of biological products in the drug-store.—Proc. California Pharm. Assoc. 1917, p. 71–72.

Phelps, I. K., and Palmer, H. E.: The separation and estimation of butyric acid in biological products.—J. Biol. Chem. 1917, v. 29, p. 199–205.

Phelps, I. I. K., and Palmer, H. E.: An experimental study of the identification and quantitative determination of lactic acid in biological products.—J. Am. Chem. Soc. 1917, v. 39, p. 136–149.

Osborne, Thos. B., et al.: A report of experiments to determine the rôle of vitamines in the diet.—J. Biol. Chem. 1917, v. 31, p. 149–163.

McCollum, E. V., and Pitts, W.: The "vitamine" and hypophysis and deficiency diseases.—J. Biol. Chem. 1917, v. 31, p. 229–253.

Williams, Robert R.: Investigations dealing with the chemical nature of the vitamines. III. The structure of the curative modifications of the hydroxypyridines.—J. Biol. Chem. 1917, v. 29, p. 495–520.

Harden, Arthur, and Zilva, Sylvester S.: The authors failed to observe any curative action of either form of 2-hydroxypyridine on polyneuritic pigeons. Similar negative results are also recorded for adenine.—Biochem. J. 1917, v. 11, p. 172–179.

Drummond, Jack C.: Unsuccessful attempts to isolate the water-soluble accessory growth-promoting substances from yeast are described. The water-soluble factor, however, is stated not to be identical with adenine, nucleic acid, or any of the constituents of commercial meat extract.—Biochem. J. 1917, v. 11, p. 255–271.

Cornalba, G.: A discussion of vitamines and the new conception of nutrition.—Boll. chim.-farm. 1917, v. 56, p. 577–580.

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Bourquelot, Em.: A study of the influence of glycerol on the activity of invertase. The activity of invertase is weakened by the presence of glycerol.—Compt. rend. acad. sc. 1917, v. 165, p. 567–569.

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Anon.: Prof. Moll, of Holland, is said to recommend that complete monographs be included in the Dutch pharmacopœia for all vegetable drugs. His reasons for this recommendation, together with a sample monograph on capsicum, are given.—Chem. & Drug. 1917, v. 89, No. 1931, p. 92–93.

Congdon, Leon A.: Among the root drugs which are quite susceptible to the attack of worms or insects are the following: Licorice, ginger, pleurisy, gentian, orris, and serpentaria. The powdered drugs most commonly affected in this manner are saffron, gentian, elm, rhubarb, belladonna, capsicum, anise, fenugreek, flaxseed,

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senna, and ginger. The seeds found to be frequently attacked by insects and worms are coriander, cumin, quince, stramonium, caraway, anise, dill, and hemp.—Proc. Kansas Pharm. Assoc. 1917, p. 89.

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André, G.: Data relative to the drying of vegetable substances at different temperatures are given.—Bull. soc. chim. France, 1917, v. 23, p. 430–437.

Alsberg, C. L.: The tentative standards of the Bureau of Chemistry for caraway seed, cumin seed, poppy seed, lavender flowers, and sage leaves are given.—S. R. A. Chem. 1917, No. 19, p. 51.

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Holm, Theo.: Medicinal plants of North America. A discussion of *Aralia* L. and *Panax* L.—Merck's Rep. 1916, v. 25, p. 11–15, 62–65, 126–130, 177–180.

De Mars, G. J.: Descriptions of some of the medicinal plants found growing in northern Minnesota are given.—Northwestern Druggist, 1916, v. 17, No. 11, p. 30–31.

Kozlov, M. N.: A preliminary report of the work at the chemical laboratory of the Sonkhoum experiment station, Caucasus, on the extraction of medicinal substances from local plants—viz, eucalyptus, wild mint, camphor, castor oil, etc.—Chem. Abstr. 1917, v. 11, p. 3094.

Beille, L.: The medicinal-plant industry. Its development in France and its future in the southeast.—Bull. Soc. pharm. Bordeaux, 1917, v. 55, p. 356–389.

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Anon.: An enumeration and description of some of the plant drugs entering into the folk remedies of the Caucasus.—Farm. Español. 1917, v. 49, p. 631–632.

Anon.: A short note on the medicinal plants of Guatemala.—Pharm. Era, 1917, v. 50, p. 154.

Jones, D. T.: A report on the medicinal plants of South Dakota. About 37 wild plants are enumerated.—Proc. Missouri Pharm. Assoc. 1917, p. 31–38.

Reimoser, Josef: Notes on the possibilities of using medicinal plants indigenous to Germany as substitutes for those imported.—Ztschr. allgem. österr. Apoth.-Ver. 1917, v. 55, p. 372, 381–382, 393–394, 401–403, and 411–412.

Reutter: A table enumerating the drugs indigenous to Switzerland, their principal constituents, their use and their cost.—Schweiz. Apoth.-Ztg. 1917, v. 55, p. 374–376.

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Van Zijp, C.: Researches on the identification of different species of curcuma.—Pharm. Weekblad, 1917, v. 54, p. 328–336.

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Cuhel, Libussa, and Milada: A pharmacognostical study of Radix *morsus diaboli*.—Pharm. Post, 1917, v. 50, p. 353–354.

Holm, Theo.: A continuation of an article describing the structure of the vegatative organs of *Panax quinquefolium* and *P. trifolium*.—Merck's Rep. 1917, v. 26, p. 6–8.

Heintzleman, P. S.: It is estimated that approximately 14,069 pounds of ginseng were imported into Canton, China, from the United States during the year 1913.—Com. Rep. 1917, No. 71, p. 1145.

J. J. H.: A review of a small pamphlet by G. Arends entitled *Volkstumliche Anwendung der einheimischen Arsneipflanzen*.—Chem. Weekblad, 1917, v. 14, p. 586.

Anon.: A book review calls attention to bulletin No. 25 of the Lloyd Library entitled *Bibliography Relating to Botany Exclusive of Floras*. Volume 2.—Pharm. Era, 1917, v. 50, p. 92.

Anon.: A review of the volume, *Handbook of Pharmacognosy* by Otto A. Wall states that the author's plan is an admirable one in that it enables the student to get a comprehensive view of the whole field of pharmacognosy, particularly as it relates to the question of identi-
[illegible].—Pharm. Era, 1917, v. 50, p. 340.

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Moser, John, Jr.: In a review of a volume by William Mansfield, entitled *Histology of Medicinal Plants*, it is stated that the book is evidently intended as an introductory course to the study of pharmacognosy, and that it should be welcomed because it shows an increasing interest in that subject.—Am. J. Pharm. 1917, v. 89, p. 89–90.

Anon.: A book review of a volume by Henry Kraemer, entitled *Scientific and Applied Pharmacognosy*, states that the work should be a success, as it is one of the most complete and best of its kind at the present time.—J. pharm. et chim. 1917, v. 16, p. 386–387.

Anon.: A book review calls attention to a bulletin published by the University of Wisconsin. entitled *Plant Chemistry for Pharmacy Students*. The bulletin is not claimed to be a text book or a laboratory manual, but merely a guide to instructors and students who are taking up the study of plant chemistry.—Pharm. Era, 1917, v. 50, p. 372.

Anon.: A review of Hygienic Laboratory Bulletin No. 105, *Digest of Comments on the Pharmacopoeia of the United States of America and on the National Formulary*, states that this vast bibliographic index should have a place in every library, where it may be consulted with profit by those who intend to undertake any work in pharmacognosy.—J. pharm. et chim. 1917, v. 15, p. 173.

Anon.: A book review of the twelfth edition of G. A. Buchheister's handbook of pharmaceutical practice states that three-fourths of the work is devoted to botany, pharmacognosy, and chemistry.—Schweiz. Apoth.-Ztg. 1917, v. 55, p. 301.

Fischelis, Robert P.: In a review of the sixth edition of *Culbreth's Materia Medica and Pharmacology* it is stated that the work has been thoroughly revised to conform to the U. S. P., IX, and that it also includes references to the important drugs and preparations of the N. F., IV.—Am. J. Pharm. 1917, v. 89, p. 324–325.

Anon.: A book review of a work by Lucius E. Sayre, entitled *Organic Materia Medica and Pharmacognosy*. The classification of plant drugs has been changed to conform to the system in use by modern authors.—Bull. Pharm. 1917, v. 31, p. 305.

Anon.: A review of the ninth edition of a book by Reynold Webb Wilcox on Materia Medica and Therapeutics.—Bull. Pharm. 1917, v. 31, p. 393.

Anon.: A review of a volume by Thomas S. Blair, entitled *Botanic Drugs, Their Materia Medica, Pharmacology and Therapeutics*.—D.-A. Apoth.-Ztg. 1917, v. 38, p. 87.

Anon.: A book review of the work entitled *The National Standard Dispensatory*, third edition.—Apothecary, 1917, v. 14, No. 4, p. 10.

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1. CULTIVATION OF MEDICINAL PLANTS.

Anon.: The N. A. R. D. has adopted a resolution to the effect that the association go on record in favor of the establishment of a pharmaceutical experiment station in every State of the Union, and the support, at least in part, of such stations by the Federal Government for the benefit of pharmacy, and in general the highly important vegetable materia medica in particular.—Apothecary, 1917, v. 29, No. 11, p. 44.

Miller, F. A.: A lecture on the cultivation of medicinal plants.—J. pharm. et chim. 1917, v. 16, p. 255–264.

Tschirch, A.: A discussion of leading viewpoints on the cultivation of medicinal plants.—Schweiz. Apoth.-Ztg. 1917, v. 55, p. 376–378.

Zornig, Heinrich: General comments on the cultivation of medicinal plants.—D.-A. Apoth.-Ztg. 1917, v. 38, p. 2–3, 25, 54–55.

Bolenbaugh, Albert: An account of the cultivation of digitalis, belladonna, cannabis, and other drugs in the vicinity of Richmond, Va.—Virginia Pharm. 1917, v. 1, p. 143–148.

Chevalier: Notes on the cultivation of mint, belladonna, stramonium, hyoscyamus, aconite, colchicum, etc. The manufacture of alkaloids by the pharmacist is advised.—Schweiz. Apoth.-Ztg. 1917, v. 55, p. 283–286.

Shenstone, J. C.: Herb growing in the British Empire; its past, present, and future.—J. Roy. Soc. Arts, 1917, v. 65, p. 445–454.

E. H. T.: Statistics relative to the cultivation of certain medicinal plants in England are presented.—J. Board Agric. 1917, v. 23, p. 1103–1104, through J. Soc. Chem. Ind. 1917, v. 36, p. 402.

Anon.: Historical notes on the cultivation of rhubarb in Great Britain.—J. Roy. Soc. Arts, 1917, v. 65, p. 596–598.

Goris, A.: Notes on the cultivation and harvesting of medicinal plants in France.—Bull. Sc. pharmacol. 1917, v. 24, p. 46–61.

Schmalz: A discussion of efforts to cultivate and harvest medicinal plants in Germany. An abstract.—Schweiz. Apoth.-Ztg. 1917, v. 55, p. 9–12.

Thoms, H.: Notes on the cultivation and harvesting of medicinal plants in Germany.—Umschau. 1917, v. 21, p. 265–266, through Ztschr. angew. Chem. 1917, v. 21, p. 257.

Senft, Em.: Notes on the cultivation of medicinal plants in Germany.—Pharm. Post, 1917, v. 50, p. 173–174 and 181–183.

Mattiorolo, O.: An enumeration of some of the medicinal plants which may be cultivated in different parts of Italy.—Giorn. farm. chim. 1917, v. 66, p. 91–94.

Anon.: A book review calls attention to a bulletin of the University of Wisconsin, entitled *Report of the Director of the Pharma- Experiment Station for the Fiscal Years July 1, 1914, to 1916.*—Pharm. Era, 1917, v. 50, p. 124.

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D. H. W.: A review of a volume on the cultivation of medicinal plants by Th. Meyer, entitled *Arzneipflanzenkultur und Kräuterhandlung Rationelle Züchtung und Verwertung der in Deutschland zu zuchtenden Arznei und Gewurzpflanzen. Eine Anleitung fur Apotheker, Landwirte und Gärtner.*—Chem. Weekblad, 1917, v. 14, p. 298–299.

Anon.: A book review calls attention to a small volume by Ada B. Tweetgen, entitled *Profitable Herb Growing and Collecting.*—Pharm. J. 1917, v. 98, p. 7.

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Millon's reagent. The ethylic necleus is identified by the formation of iodoform, and the aldehydic nucleus by distilling the substance with dilute sulphuric acid and manganese dioxide and testing the filtrate with magenta-sulphurous acid reagent. With bromine, novocaine yields a yellow precipitate which dissolves when the mixture is heated.—Rev. Farm. 1917, v. 60, p. 699.

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Sakei, K.: Researches on the constituents of *Cnidium officinale* [illegible]no. "The chief ingredient of the extract of this drug is a volatile oil of cnidium—which is present to the extent of about 0.82 [illegible] The chief action of the oil is to stimulate the vasocon-

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Issoglio, G.: A report of chemical researches on *Elaphomyces hirtus*. The plant was found to contain stearin, traces of alkaloids, mannite, inulin, and para-isodextrane.—Gazz. chim. ital. 1917, v. 47, p. 31.

Kobert, R.: Notes on the poisonous constituents of crocus and tulip roots.—Chem. Ztg. 1917, p. 63, through Pharm. Weekblad, 1917, v. 54, p. 993.

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8. ASSAY PROCESSES.

Snyder, J. P.: To one who has found it necessary to perform analytical work under the U. S. P., VIII, and the U. S. P., IX, it is apparent that there is a decided improvement in the chemical assays of the latter, and although there is no doubt room for still further improvement, there are but few chemical methods which will not admit of some change when closely scrutinized.—J. Am. Pharm. Assoc. 1917, v. 6, p. 712.

Fuller, H. C.: The directions in the U. S. P. for conducting the proximate assays are too loosely worded. They place too much responsibility on the worker, who, unfortunately, is often too inexperienced to assume this responsibility. The personal equation of the drug analyst, even of wide reputation, is, to quote Kipling, "beyond the wit of any man, black or white, to fathom."—J. Am. Pharm. Assoc. 1917, v. 6, p. 70.

Kilmer, Fred B.: The American Drug Manufacturers' Association at its stated meeting held in February, 1917, caused to be established what is called a committee on standards and deterioration. The duties of the committee will be to promulgate suggestions for the improvement of assay methods and standards for the firms represented.—Proc. New Jersey Pharm. Assoc. 1917, p. 86–87.

Klein, Friedrich: In order to eliminate the danger of formation of troublesome emulsions in carrying out some of the alkaloidal assays

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of the U. S. P., the use of ethyl acetate and ether in place of chloroform is recommended.—D.-A. Apoth.-Ztg. 1917, v. 38, p. 52.

Anon.: Under laboratory notes from the H. K. Mulford Co. it is stated that, owing to the tenacity with which alkaloidal residues obtained by extraction with chloroform retain the latter, such residues should be treated with ether before attempting to dry them to constant weight.—Drug. Circ. 1917, v. 61, p. 25.

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Asher, Philip: An enumeration of the assay processes which are not included in the present Pharmacopœia, but for which there is a great need.—Am. J. Pharm. 1917, v. 89, p. 174–175.

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Santí, Luigi: A general discussion of the evaluation of medicinal extracts, followed by specific directions for the assay of a number of the more commonly used preparations of this class.—Boll. chim.-farm. 1917, v. 56, p. 477–481, 497–500, and 517–521.

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Pinnow, J.: A report of experiments on the systematic extraction of substances from aqueous solutions with ether.—Ztschr. Nahr.-Genussm. 1916, v. 32, p. 257–268, through Chem. Abstr. 1917, v. 11, p. 127.

Rasmussen, H. B.: A method for the exact estimation of atropine is described. The formation of an insoluble salt by the addition of a slight excess of silicotungstic acid to an acid solution of atropine or its isomerides is made the basis of the test.—Ber. deutsch. pharm. Gesellsch. 1917, v. 27, p. 193–201, through J. Chem. Soc. Lond. 1917, v. 112, part 2, p. 431.

Hebeisen, F.: Data obtained in the examination of anthraquinone containing drugs by the use of the Tschirch-Van Warin colorimetric method.—Apoth. Ztg. 1917, p. 95, through Pharm. Weekblad, 1917, v. 54, p. 1359.

Débourdeaux, Léon: Modifications of Maupy's method for the estimation of theobromine in cocoa are described.—J. pharm. et chim. 19[illegible] 306–311.

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Radford, Norah, and Brewer, G.: A description of a method for the quantitative determination of theobromine. The theobromine is precipitated as a silver compound, and the quantity of nitrogen in the latter is estimated.—Analyst, 1917, v. 42, p. 274–276.

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Tingle, A., and Ferguson, A. A.: A description of a new method for the determination of nicotine in tobacco.—Trans. Roy. Soc. Canada, 1916, v. 10, p. 27, through J. Chem. Soc. 1917, v. 112, p. 55.

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Year.	Total.	Above.	Below.	Per cent above.
Report of—				
1909	395	313	82	79.3
1910	340	291	49	85.6
1911	263	224	39	85.1
1912	298	235	63	78.8
1913	382	264	118	69.1
1914	286	221	65	77.2
1915	133	98	35	73.6
1916	214	156	58	72.9
1917	172	147	25	85.3

Proc. Pennsylvania Pharm. Assoc. 1917, p. 92.

9. PHYSIOLOGICAL STANDARDIZATION.

Snyder, J. P.: The admission into the U. S. P., IX, for the first time of biological assays is undoubtedly a step in the right direction and, while these assays are, no doubt, far from perfect and will be subject to severe criticism, eventually much good must come from that criticism and we will obtain much better methods for physiological assays.—J. Am. Pharm. Assoc. 1917, v. 6, p. 714

Hamilton, Herbert C.: A general discussion of the biological standardization methods of the U. S. P.—Am. J. Pharm. 1917, v. 89, p. 61–70.

Dohme, A. R. L.: Practically all of the new physiological processes in the U. S. P. are not satisfactory and require revision, notably that for cannabis and digitalis.—Proc. N. W. D. A. 1917, p. 503.

Pittenger, Paul S.: A comprehensive discussion of the biological assay methods of the U. S. P., IX.—J. Am. Pharm. Assoc. 1917, v. 6, p. 865–872.

van Leeuwen, W. Storm: A discussion of the comparative values of biological and chemical methods for the assay of drugs and medi

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cines. The section on biological assays in the U. S. P., IX, is also discussed.—Pharm. Weekblad, 1918, v. 54, p. 391–412.

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Lascoff, J. Leon: First and foremost, it is the duty of the pharmacist to see that his preparations are not only elegant in appearance but also active in their ingredients. A real working knowledge of the appearance and properties of the essential drugs is a *sine qua non* for the man who sets out to manufacture his own preparations according to the U. S. P.—J. Am. Pharm. Assoc. 1917, v. 6, p. 473.

Asher, Philip: Chemical facts on the preparation of some U. S. P. and N. F. galenicals.—Southern Pharm. J. 1917, v. 10, p. 80–82, 128–130, 188–190.

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Cowie, W. B.: Notes on the risks incurred in using commercial glucose in pharmaceutical preparations.—Pharm. J. 1917, v. 98, p. 235–236.

Lyonnet, B.: The number of firms exhibiting pharmaceuticals at the last international exposition held at Lyon was 32. At the first of these fairs, held at the beginning of the war, only nine firms exhibited pharmaceutical products. The exhibits included such preparations as arsenobenzole, novarsenobenzol, allocaine, etc.—Lyon Médical, 1917, v. 126, p. 195; J. Am. M. Assoc. 1917, v. 68, p. 1786.

Delépine, Marcel: A general discussion of the preparations of benzoate of mercury in which the mercury salt is rendered water-soluble by the addition of sodium chloride.—Bull. sc. pharmacol. 1917, v. 24, p. 329–335.

Llewellyn, J. F.: A short article on the medicines used by the ancient Syrians.—Drug. Circ. 1917, v. 61, p. 117–118.

Kraemer, Henry: In a review of the third edition of *The National Standard Dispensatory* it is stated that, although the authors an[illegible] the work has been thoroughly revised and is up to date, [illegible]n the truth. The addition of the complete pure food

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and drugs act and regulations, as well as the Harrison narcotic law, is stated to be the most prominent feature of the new work,—Am. J. Pharm. 1917, v. 89, p. 90–91.

Fischelis, Robert P.: In a book review of the second edition of Arny's *Principles of Pharmacy*, it is stated that perhaps the greatest distinctive feature of the work is the excellent and extensive bibliography given at the end of each chapter.—Am. J. Pharm. 1917, v. 89, p. 322–323.

Beringer, George M.: A review of the fifth enlarged and revised edition to a work by Charles Caspari, jr. entitled *A treatise on Pharmacy for Students and Pharmacists.*—Am. J. Pharm. 1917, v. 89, p. 42–45.

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1. GENERAL FORMULAS.

Beringer, George M.: One one of the most noteworthy advances in the revision of the Pharmacopœia has been the adoption of type processes under fluid extracts and tinctures, thus saving a number of pages in the book and avoiding the unnecessary repetition of instructions.—Am. J. Pharm. 1917, v. 89, p. 15.

Brown, L. A.: The adoption of typical formulas for galenical preparations has resulted in much saving of space, obviating much needless repetition of directions. Four type processes are given for fluid extracts, two for tinctures, and one for medicated waters.—Bull. Kentucky Agric. Exper. Sta. 1917, Feb. 15, p. 2.

2. STANDARDIZATION.

Penick, S. B.: The standards that our new Pharmacopœia has provided for botanical drugs speaking generally, are unquestionably wise and not unreasonable. Those drugs for which our chemists have been unable to establish chemical methods for determination of quality are provided for by other standards which will safeguard the public against anything that is not true to name and of the best quality.—J. Am. Pharm. Assoc. 1917, v. 6, p. 695.

Rusby, H. H.: A discussion of the importance of establishing practical standards for drugs amd medicines.—Proc. Am. Drug Mfg. Assoc. 1917, p. 8–11.

Anon.: A resolution to the effect that the clause in H. R. 4960, which empowers the United States Public Health Service to determine the potency and toxicity of products used for the prevention of diseases of man, manufactured by a citizen of the United States under any patent owned by the enemy or ally of the enemy, when licensed by the Federal Trade Commission, be stricken out, because

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the power of fixing standards for medicinal products should not be delegated by Congress to any branch of the Federal Government.—Proc. Wisconsin Pharm. Assoc. 1917, p. 101.

Anon.: At the meeting of the National Drug Trade Conference at Washington, January 16, the establishment of arbitrary standards for foods and drugs beyond those already made was opposed.—Am. Perf. 1917, v. 11, p. 351.

Editorial: In a discussion of the subject of drug standardization, it is stated that no bureaucracy can be trusted with such important work—particularly the Bureau of Chemistry, which has not seen fit to deny its laxity in the examination of drugs entering at the port of New York.—Oil, Paint & Drug Rep. 1917, v. 91, No. 2, p. 13.

3. GALENICALS.

Beringer, George M.: Reasons for some of the changes in the formulas of galenicals made in the ninth revision of the U. S. P.—Am. J. Pharm. 1917, v. 89, p. 348–353; Western Drug. 1917, v. 39, p. 220–221.

Lascoff, J. Leon: An enumeration of some of the changes which have been made in the galenicals of the U. S. P., IX.—Pract. Drug. 1917, v. 35, No. 5, p. 24–26.

Beringer, George M.: Notes on some of the newer galenical preparations of the N. F., IV.—Proc. New Jersey Pharm. Assoc. 1917, p. 91–92.

Heiduschka, A., and Schmid, J.: A study of the behavior of certain galenicals, tinctures, and extracts, toward Fehling's solution for the purpose of determining their value.—Apoth.-Ztg. 1916, v. 31, p. 399, through Chem. Abstr., 1917, v. 11, p. 1719.

Wastenson, H.: A description of a method for the determination of mercury in galenical preparations. The method is stated to be superior to that of either Swedish or German pharmacopoeias.—Svensk farm. Tidskr. 1917, v. 21, p. 54–59.

Kunz-Krause, H.: Descriptions of methods for the recognition of minute quantities of pyridine in galenical preparations.—Apoth.-Ztg., 1916, v. 31, p. 403–404, through Chem. Abstr. 1917, v. 11, p. 1721.

Haines, C. J., and Marden, J. W.: A method for the determination of alcohol in galenicals is based on the fact that C_2H_5OH may be separated from aqueous solution by saturating the latter with KF.—J. Ind. & Eng. Chem. 1917, v. 9, p. 1126–1127.

Aronstamm, George C.: Notes on various methods for determining the alcoholic content of medicinal preparations.—Bull. Pharm. 1917, v. 31, p. 26–28.

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DETERIORATION.

Congdon, Leon A.: Notes on the deterioration of various elixirs.—Proc. Kansas Pharm. Assoc. 1917, p. 89.

Congdon, Leon A.: In a report on the inspection of drug stores in Kansas, the tinctures and fluid extracts most commonly found in a deteriorated condition are enumerated. Data are also given showing the properties of some deteriorated fluid extracts.—Proc. Kansas Pharm. Assoc. 1917, p. 85–92.

Buhrer, C.: A discussion of precipitation phenomena in fluid extracts and of the causes producing the same.—Schweiz. Apoth.-Ztg. 1917, v. 55, p. 4–7.

Romanelli, R.: Camphor is recommended as a preservative of aqueous solutions prone to deteriorate on keeping.—Drug. Circ. 1917, v. 61, p. 232; Chem. Abstr. 1917, v. 11, p. 1722; J. Am. M. Assoc. 1917, v. 68, p. 1011.

Fleming, Fred: Facts concerning the deterioration of certain biological products.—Pacific Pharm. 1917, v. 11, p. 84–87.

François, Maurice: A report of researches conducted for the purpose of determining the rate of decomposition of mercuric lactate and aqueous solutions of the same.—J. pharm. et chim. 1917, v. 15, p. 33–41.

4. INCOMPATIBILITY.

Berger: A review of some of the more important work in incompatibilities.—Schweiz. Apoth.-Ztg. 1916, v. 54, p. 145–148.

Anon.: A discussion of the behavior of a large number of the official drugs when combined with other substances.—N. A. R. D. J. 1917, v. 23, p. 815–816, 896–897, 1036, 1160–1161, v. 24, p. 107–108, 154–155, 502, 542, 578–579, 675–676, 784–785, 831, 937, 971, v. 25, p. 105–106, 236–237, 408–409, 529–530.

Astruc, A., and Cambe, J.: Observations on the incompatibilities of certain phenolic compounds, thymol, phenol, β-naphthol, resorcinol, guaiacol, pyrogallol, etc.—J. pharm. et chim. 1917, v. 15, p. 383–386; Farm. Españ. 1917, v. 49, p. 568–469, 580–581.

Astruc, F., and Cambe, J.: On the incompatibility of sodium bicarbonate with certain salicylates, especially bismuth salicylate.—Farm. Españ. 1917, v. 49, p. 88–89; see also E. Canals, p. 231–232.

Hegnel: Some observations on incompatible mixtures, with special reference to sodium bicarbonate in irrational prescriptions.—Boll. chim.-farm. 1917, v. 56, p. 280.

Anon.: A note calls attention to the incompatibility of bismuth subnitrate with sodium hypophosphite if dispensed in powder papers which do not exclude moisture.—Rev. Farm. 1917, v. 60, p. 438.

Elliot, George: A note calling attention to an incompatible tar ointment. The ointment in question contained yellow oxide of

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mercury and zinc oxide in addition to tar.—Pharm. J. 1917, v. 99, p. 283.

Mannich, C.: Notes on the incompatibility of antipyrine with hexamethylenaminetetramine or formaldehyde preparations in the presence of acids.—Boll. chim.-farm. 1917, v. 56, p. 279.

Utech, P. Henry: Whenever hydrogen peroxide is combined with solutions containing menthol, vanillin, cinnamic aldehyde, oil of lemon, oil of peppermint, or volatile oil of almonds, the flavor of the solution is entirely destroyed within a short time.—Drug. Circ. 1917, v. 61, p. 398.

Anon.: A book review of a volume by Edsel A. Ruddiman, entitled *Incompatibilities in Prescriptions*, refers to the volume as the most complete text known on the subject of incompatibilities.—Midl. Drug. 1917, v. 51, p. 258.

5. EXTRACTION.

Beringer, George M.: For the first time the U. S. P., IX, directs that fractional or divided percolation be employed in the preparation of certain fluid extracts—namely, the fluid extracts of aconite, aromatic powder, and bitter orange peel.—Am. J. Pharm. 1917, v. 89, p. 18.

Buhrer, C.: Some comments on the percolation of fluid extracts.—Schweiz. Apoth.-Ztg. 1917, v. 55, p. 4–7.

Palme, H., and Winborg, G.: Data showing the effect of the adsorption phenomenon on the extraction of alkaloids from drugs.—Svensk farm. Tidskr. 1917, v. 21, p. 21–23 and 37–41.

6. STERILIZATION.

Gay, Mrs. St. Claire Ransford: Among the commendable additions to the U. S. P. are the instructions on sterilization. These are concise enough to form a part of the every-day régime of even the department drug store, but no doubt, simple as they are, they will be discarded by many, except upon the visit of the inspector.—J. Am. Pharm. Assoc. 1917, v. 6, p. 607.

Dean, J. Atlee: Notes on the sterilization of pharmaceutical products.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 146–148.

Lascoff, J. Leon: A discussion of methods for the preparation and dispensing of sterilized solutions.—Pract. Drug. 1917, v. 35, No. 8, p. 27–28.

Davis, C. T.: British patent No. 102511. A process for the sterilization and storing of surgical ligatures consists of placing the ligatures or sutures in a liquid of such a nature that it will serve both for sterilizing during the process of heating and also for the subsequent preservation.—Chem. Abstr. 1917, v. 11, p. 1015.

H., and Bird, Lloyd C.: A description of a practical the sterilization of glasses at the soda fountain.—Vir. 1917, v. 1, p. 181–183.

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Goris, A.: A comprehensive discourse on the preparation and sterilization of catgut for sutures.—Bull. Sc. pharmacol. 1917, v. 24, p. 79–81, 141–154.

Anon.: A book review of a volume by A. Sartory, entitled *A Practical Guide to Bacteriological Manipulations for the Use of Pharmacists.*—Pharm. Weekblad 1917, v. 54, p. 105.

7. FORMS OF ADMINISTRATION.

Fette, George T.: A discussion of the applications of the laws of physical chemistry in electrolytic (ionic) medication.—Dental Cosmos, 1917, v. 59, p. 264–271.

Kesteven, Leighton: Some notes on ionic medication and the method of administration.—Brit. M. J. 1917, v. 2, p. 423–424.

Koller, H.: Therapeutic iontophoresis. Descriptions of extensive experiments made with the ions of heavy metals by passing them through dead animal membranes and through rabbit's ears. An abstract.—J. Am. M. Assoc. 1917, v. 68, p. 1878.

Sturridge, Ernest: A discussion of ionic medication, with special reference to the zinc ion.—Dental Cosmos, 1917, v. 59, p. 793–795.

Haldane, J. S.: A description of a convenient apparatus for the therapeutic administration of oxygen.—Brit. M. J. 1917, v. 1, p. 181–183.

Kobert, R., and Triller, L.: Biological investigations have shown that three groups of substances (astringents) are responsible for the therapeutic action of mud baths—soluble aluminum salts, soluble ferric salts, and free humus acids.—Chem. Zentralbl. 1916, II, 338–339 through Chem. Abstr. 1917, v. 11, p. 1723.

Jacquot: Methods for the preparation of concentrated solutions of benzoate of mercury and calomel in oil are described.—Bull. Sc. pharmacol. 1917, v. 24, p. 83–85.

Anon.: A book review calls attention to a small volume by Bernard Fantus entitled *Candy Medication*—Pharm. Era, 1917, v. 50, p. 340.

AMPOULES.

Rogers, R. R.: A detailed discussion of ampoule medication, including descriptions of methods for the filling of ampoules, their sterilization, and manner of use.—Proc. California Pharm. Assoc. 1917, p. 54–58.

Paul, Theodor: A discussion of the changes suffered by liquid medicaments in glass, together with the causes and phenomena productive thereof and incidental thereto. In order to obviate such disadvantages, the use of "dry and liquid ampoules" is recommended, the idea being to mix the medicament and water, contained in separate am-

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poules, just prior to application.—Sudd. Apoth.-Ztg. 1916, v. 56, p. 459–460, through Chem. Abstr. 1917, v. 11. p. 864.

CAPSULES.

Harner, Alice T.: A nontechnical paper describing the manufacture of gelatin capsules.—Spatula, 1917, v. 23, p. 109–110.

Dershimer, F. W.: Experimental data relating to insolubility of soft gelatin capsules are presented.—J. Am. M. Assoc. 1917, v. 69, p. 1508–1509.

Anon.: Directions are given for preparing capsules suitable for the administration of castor oil.—Pharm. Era, 1917, v. 50, p. 121.

COMPRESSED TABLETS.

Roller, Emil: Owing to the importance of tablets in hypodermic medication and to the fact that they have practiaclly replaced pills for internal administration, it is thought that the Pharmacopœia should at least have included type formulas for the more important of these preparations.—D.-A. Apoth.-Ztg. 1917, v. 38, p. 31.

Street, John Phillips: Tablets obtained from the stocks of practicing physicians showed a variation in weight of from 10 to 20 per cent and a variation in amount of active ingredient stated of from 5 to 50 per cent.—Rep. Conn. Agric. Exper. Sta. 1917, p. 188–189.

van Itallie, E. I.: Notes on the preparation of compressed tablets.—Pharm. Weekblad, 1917, v. 54, p. 1205–1215

Miller, Reginald: A description of methods for the analysis of rhinitis tablets and for tablets containing salol and quinine sulphate.—Am. J. Pharm. 1917, v. 89, p. 214–217.

II. INTERNATIONAL STANDARDS.

1. THE EVOLUTION OF UNIFORMITY IN PHARMACOPŒIAL STANDARDS AND STANDARDS FOR POTENT MEDICAMENTS.

1. ADOPTION OF BRUSSELS CONFERENCE PROTOCOL.

Maben, Thos.: Notes on the U. S. P., IX, monographs. The lack of attention given the P. I., especially in the case of potent drugs, is criticized.—Chem. & Drug. 1917, v. 89, p. 71–72.

Beringer, George M.: As some of the recommendations made in the protocol of 1902 have not been universally accepted, and as progress in the medical sciences since that time has presented some new problems, there is now great need for another international conference.—Am. J. Pharm. 1917, v. 89, p. 572.

2. FOREIGN PHARMACOPŒIAS.

[illegible]al: An examination of the pharmacopœias of the world [illegible]tartling fact that only 19 of them have been revised

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since 1900, and only three since 1911, five years ago—the British, the Norwegian, and the United States. Only the Argentine standards have, of all the South American States, been revised in this century. An examination of existing pharmacopœias shows scores of drugs hardly known in modern medicine. As an example, *Cnicus Benedictus* (Cardui), of recent notoriety, is recognized in the Belgian, Croatian, German, Japanese, Netherlands, Russian, Swedish, and Swiss pharmacopœias. By comparison, the British and United States pharmacopœias, the most recently revised, are ultrascientific.—Midl. Drug. 1917, v. 51, p. 7.

1. BRITISH.

Anon: A criticism pointing out that the convenient rule of solids by weight and liquids by measure is not consistently followed in the Ph. Brit.—Chem. & Drug. 1917, v. 89, p. 117.

Anon: In pursuance of the medical act of 1858 and of the medical council act of 1862 the following are excluded from the British Pharmacopœia, 1914: Most of the confections, the glycerines, all but three mixtures, most of the syrups, a number of the troches, a number of the powders, and other galenicals.—Chem. & Drug. 1917, v. 89, No. 1958, p. 37.

2. NORWEGIAN.

Anon: A book review of a commentary on the Norwegian pharmacopœia by Frode Lieungh and G. Rustung.—Arch. Pharm. Chem. 1917, v. 24, p. 308.

3. ITALIAN.

Anon.: A discussion of the advisability of omitting the chapter on specialties from the fourth edition of the Ph. Ital.—Giorn. farm. chim. 1917, v. 66, p. 344–346; Boll. chim.-farm. 1917, v. 56, p. 503–505.

Lami, Pio: A discussion relative to the introduction of lecithin into the Codice Ufficiale.—Boll. chim.-farm. 1917, v. 56, p. 34–39.

4. SWISS.

Fleissig, P.: A plea for a revised edition of the Swiss pharmacopœia, which will take into account the advances made since 1907. It is suggested that the chapters on sterilization and ampoules be extended; that newer remedies and physiological assay methods be included; and that certain obsolete drugs and preparations be dropped.—Schweiz. Apoth.-Ztg. 1917, v. 55, p. 517–523.

Zörnig: A discussion of the revision of the Ph. Helv. IV with respect to the drugs which it contains.—Schweiz. Apoth.-Ztg. 1917, v. 55, p. 613–617.

Anon.: A book review calls attention to a small volume entitled *Extractum Ph. H. IV.* The volume contains formulas for the

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galenical preparations of the Swiss pharmacopœia in Latin, and is intended for use in the laboratory.—Schweiz. Apoth.-Ztg. 1917, v. 55, p. 93.

5. DUTCH.

van der Haar, A. W.: A critical review of the fourth edition of the Dutch pharmacopœia.—Pharm. Weekblad, 1917, v. 54, p. 492–501.

6. BRAZILIAN.

Anon.: According to the Uniao Pharmaceutica, the publication of a Brazilian pharmacopœia was strongly advocated at the recent medical congress held at Sao Paulo. The French Codex is the work in general use in Brazil at the present time.—Am. Druggist, 1917, v. 65, No. 4, p. 58.

7. DANISH.

Haase, F. F., Angelo: A short article comparing the drugs and preparations of the Danish pharmacopœia, 1907, with those of the U. S. P., IX.—D.-A. Apoth.-Ztg. 1917, v. 38, p. 32, 44-45.

III. COMMENTS ON OFFICIAL ARTICLES.

ACACIA.

Southard, Addison E.: The American supply of gum acacia is stated to be procured largely from Sudan. It is stated, however, that the Somali gum in the Aden market is equal in quality to that of Sudan.—Com. Rep. 1917, No. 24, p. 376.

Waters, C. E., and Tuttle, J. B.: A study of the qualitative and quantitative tests for gum acacia. The precipitate formed with basic lead acetate is pronounced to be the most characteristic qualitative test.—J. Ind. & Eng. Chem. 1916, v. 8, p. 415; Am. Druggist, 1917, v. 65, No. 1, p. 32.

Montandon,H.: Descriptions of substitutes for gum arabic yielded by Brazilian plants.—Bull. Agric. Intell. 1916, v. 7, p. 1295–1296 through J. Soc. Chem. Ind. 1917, v. 36, p. 155.

Hurwitz, S. H.: A report on the use of an acacia-Locke solution for combating the immediate ill effects of lowered pressure following excessive hæmorrhage.—J. Am. M. Assoc. 1917, v. 68, p. 699.

ACETANILIDUM.

Merrill, David R., and Adams, Elliott Q.: A study of the hydrolysis of acetanilid by means of acids.—J. Am. Chem. Soc. 1917, v. 39, p. 1588–1598.

Tunmann, O.: Reactions for the identification of acetanilid are desc[illegible] —J. Chem. Soc. Lond. 1917, v. 112, part 2, p. 551–553, t[illegible]-Ztg. 1917, v. 32, p. 289–292 and 298–299.

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Roberts, J. G.: Two samples of acetanilid examined were considered undesirable, as they were gray in color. Another sample yielded 0.08 per cent excess of ash.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 78.

Emery, W. O.: A description of a method for the estimation of acetanilid and sodium salicylate in mixtures.—J. Assoc. Off. Agric. Chem. 1916, v. 2, p. 70–71.

Emery, W. O.: A method for the estimation of caffeine, acetanilid, and codeine sulphate in mixtures containing the three substances is described.—J. Assoc. Off. Agric. Chem. 1916, v. 2, p. 72–73.

Emery, W. O.: A description of a method for the estimation of caffeine, acetanilid, quinine, and morphine in mixtures containing these substances.—J. Assoc. Off. Agric. Chem. 1916, v. 2, p. 73–74.

ACETONUM.

Asher, Philip: An explantion of the chemistry of the U. S. P., IX, method for the assay of acetone.—Am. J. Pharm. 1917, v. 89, p. 167.

Klein, Friedrich: Acetone as a product of wood distillation often contains methyl alcohol. As the U. S. P. does not prescribe a test for the latter, the author recommends a method for its detection which is based on the solubility of urea in methyl alcohol.—D.-A. Apoth.-Ztg. 1917, v. 38, p. 52.

Hubbard, Roger S.: A description of a titration method for determining minute quantities of acetone.—J. Biol. Chem. 1917, v. 29, p. 14.

Bagster, Launcelot S.: A note on compounds formed by the combination of calcium chloride with acetone.—J. Chem. Soc. 1917, v. 111, p. 494–497.

ACETPHENETIDINUM.

Tunmann, O.: Reactions for the identification of phenacetin are described.—Apoth.-Ztg. 1917, v. 32, p. 289–292 and 298–299, through J. Chem. Soc. Lond. 1917, v. 112, part 2, p. 551–553.

Miller, Reginald: A description of a rapid method for the approximate determination of phenacetin when mixed with acetanilid.—Am. J. Pharm. 1917, v. 89, p. 156–157.

ACIDUM ACETICUM.

Badsche Anilin and Soda-Fabrik: D. R. P. 294724. A description of a method for the preparation of acetic acid in which acetaldehyde is oxidized by air in the presence of iron compounds and organic salts of alkalies or alkaline earths, including magnesium and aluminum.—J. Soc. Chem. Ind. 1917, v. 36, p. 503.

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Roberts, J. G.: A strength of 100.7 per cent was indicated in the examination of one lot of acetic acid which contained an excess of empyreumatic substance.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 78.

ACIDUM ACETICUM GLACIALE.

Klein, Friedrich: Selenium dioxide is recommended as a reagent for testing glacial acetic acid. Upon warming selenium dioxide with acetic acid anhydride, a red precipitate is formed. With glacial acetic acid no precipitation occurs.—D.-A. Apoth.-Ztg. 1917, v. 38, p. 52.

Schoorl, M.: An investigation of glacial acetic acid with reference to its water content.—Pharm. Weekblad, 1917, v. 54, p. 945–949.

Szeberenyi, P.: A description of a method for the detection of mineral acids in glacial acetic acid.—Ztschr. Unters. Nahr. u. Genussm. 1916, v. 31, p. 16, through Pharm. Weekblad, 1917, v. 54, p. 646.

ACIDUM ACETYLSALICYLICUM (NONOFFICIAL).

Roberts, J. G.: The fact that plenty of acetylsalicylic acid of excellent quality and fully as desirable as the foreign product is now produced in the United States should be made known to the buying public, so that they will not be compelled to pay the excessive price formerly charged for this article.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 79.

Dohme, A. R. L.: The committee on standards and deterioration of the American Drug Manufacturers' Association finds it desirable to fix a standard of purity for acetylsalicylic acid.—Proc. Am. Drug. Mfg. Assoc. 1917, p. 184.

Slack, H. F.: Aspirin crystallizes from chloroform in three forms—two as needles and the third as flat, square tablets.—Chem. & Drug. 1917, v. 89, p. 1107.

Tsakalotos, D. E., and Horsch, S.: The fifth installment of a report of researches on aspirin deals with the effect of salicylosalicylic acid on the solidification of aspirin in concentric rings.—Bull. soc. chim. France, 1917, v. 23, p. 16–18.

Wolf, Arvid: Data are given showing the velocity constants in the hydrolysis of acetylsalicylic acid, determined in solutions with and without the additin of acid catalyzer.—Svensk kem. Tidskr. 1917, v. 29, p. 109–112.

Tsakalotos, D. E.: A reply to a criticism by François concerning the melting point of aspirin, which he maintains is uncertain.—J. pharm. et chim. 1917, v. 16, p. 336–339.

[illegible] Reginald: A description of a method for the quantitative [illegible]n of acetylsalicylic acid when admixed with sodium [illegible]m. J. Pharm. 1917, v. 89, p. 347–348.

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François, Maurice: Descriptions of tests for the identity and purity of aspirin.—J. pharm. et chim. 1917, v. 15, p. 213–222; see also D. E. Tsakalotos, p. 336–339.

Anon.: A description of a method for the quantitative determination of the combined salicylic acid in acetylsalicylic acid.—Arch. Pharm. Chem. 1917, v. 24, p. 45.

Miller, Reginald: A description of a method for the approximate determination of novaspirin alone or when mixed with aspirin.—Am. J. Pharm. 1917, v. 89, p. 155–156.

Bouvet: After discussing the acetylsalicylates of sodium, lithium, calcium, magnesium, potassium, zinc, copper, silver, and mercury, the author concludes that the calcium salt is best suited for pharmaceutical use, especially in the form of tablets or cachets. A bibliography is appended.—Bull. sc. pharmacol. 1917, v. 24, p. 86–90.

Stiell, W. F.: A report of a case of chronic poisoning due to the continued use of aspirin.—Practitioner, 1917, v. 99, p. 293–294.

Anon.: Notices of judgment Nos. 4575, 4598, 4675, 4677, 4686, 4692, and 4746 relate to the adulteration of aspirin.—S. R. A.–Chem. 1917, p. 107, 138, 233, 235, 244, 250, 313.

Massy and Sauvestre, L.: A discussion of data obtained in the analyses of different samples of aspirin tablets.—Bull. Soc. pharm., Bordeaux, 1917, v. 55, p. 229–234.

Dohme, A. R. L.: All lots of acetylsalicylic acid examined were of good quality. One lot was particularly fine, as it was 99.99 per cent pure and yielded only 0.006 per cent residue on ignition.—Proc. N. W. D. A. 1917, p. 514.

E'we, G. E.: One lot of acetyl salicylic acid examined had a pronounced acetic acid odor, but was otherwise satisfactory. Another lot contained only 61.3 per cent of acetylsalicylic acid, the remainder being a gum resembling tragacanth and free salicylic acid.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 78.

Lea, E. J.: One sample of acetylsalicylic acid examined was adulterated with milk sugar and tartaric acid.—Bull. California Bd. Health, 1917, v. 12, p. 345.

Dohme, A. R. L.: One sample of aspirin was rejected, the melting point being as low as 124° C. Three samples were below 130° C. Two of these had an odor of phenol.—Proc. N. W. D. A. 1917, p. 508.

Sayre, L. E., et al.: One of five samples of aspirin tablets examined was adulterated and misbranded.—Rep. Kansas Bd. Health, 1916. v. 12, p. 427.

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Table showing some of the analytical results reported for acetylsalicylic acid.

Reporters.	Number of samples—		References.
	Examined.	Rejected.	
Barnard, H. E.....	1	1	Bull. Indiana Bd. Health, 1917, v. 20, p. 135.
Casey, F. W.....	21	9	Bull. Michigan D. & F. Dept. 1917, No. 258–259, p. 18; No. 260–261, p. 33; No. 262–263, p. 13.
Chicago health committee.	127	31	J. Am. Pharm. Assoc. 1917, v. 6, p. 310.
Congdon, Leon A..	60	36	Proc. Kansas Pharm. Assoc. 1917, p. 87.
Lea, E. J.....	12	8	Rep. California Bd. Health, 1917, p. 162.
Sayre et al.....	16	2	Rep. Kansas Bd. Health, 1917, v. 13, p. 172.
Tice, William G...	13	1	Rep. New Jersey Dept. Health, 1917, p. 62.

ACIDUM BENZOICUM.

Dohme, A. R. L.: The committee on standards and deterioration of the American Drug Manufacturers' Association finds it desirable to devise methods for distinguishing natural benzoic acid from synthetic benzoic acid.—Proc. Am. Drug Mfg. Assoc. 1917, p. 184.

Dohme, A. R. L.: Organic impurities, which impart a dark color and foreign odor, are frequently noticed in benzoic acid.—Proc. N. W. D. A. 1917, p. 509.

Roberts, J. G.: About one-half of the lots of benzoic acid examined were of subnormal quality. Six lots had an objectionable yellowish-brown color and yielded excessive amounts of ash. Two of these also contained an excess of carbonizable impurities. One lot was particularly poor, as it yielded 0.17 per cent excess of ash. It also had an objectionable color and odor and was only 98.7 per cent pure.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 78.

Dohme, A. R. L.: One lot of benzoic acid examined was not of U. S. P. quality, as it was low in acidity, yielded 0.034 per cent more residue than the U. S. P. standard of 0.05 per cent, contained more than a normal amount of carbonizable impurities, and had a dark color.—Proc. N. W. D. A. 1917, p. 514.

Stavlin, W.: Notes on the detection of benzoic acid in fats.—Chem. Ztg. 1916, p. 770, through Pharm. Weekblad, 1917, v. 54, p. 131–132.

ACIDUM BORICUM.

St. John, B. H.: A description of a volumetric method for the determination of boric acid. A feature of importance in the method is the use of methyl red in the presence of glycerin as an indicator.—Am. J. Pharm. 1917, v. 89, p. 8–10.

Kopke, O.: A report on Pfijl's method for determining boric acid in food products.—Arb. k. Gsndhtsamte, through Pharm. Weekblad, 1917 166.

S report of a case of poisoning by boric acid mistaken fo phate.—Lancet, 1917, v. 193, p. 162.

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ACIDUM CITRICUM.

Anon.: A comprehensive article dealing with the preparation of citric acid by fermentation.—Rev. Farm. 1917, v. 60, p. 107–121.

Broeksmit, T. C. N.: Methods for distinguishing between citric and tartaric acid. The presence of tartaric acid in citric acid can be demonstrated by the formation of potassium hydrogen tartrate.—Pharm. Weekblad, 1917, v. 54, p. 686–687.

Obregon y Garcia, J. G.: A description of a method for differentiating between citric and tartaric acids. The reagents employed are a 1:1000 aqueous solution of methylene blue and an aqueous solution of potassium permanganate of the same strength.—Farm. Espan. 1917, v. 49, p. 8.

Broeksmit, T. C. N.: A method for differentiating between citric and malic acids. Both malic and citric acids answer to the iodoform test, but can be distinguished by the fact that barium malate is not precipitated, either in neutral solution or in the presence of acetic acid.—Pharm. Weekblad, 1917, v. 54, p. 1371–1373.

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Enell, Henrik: A note on the use of iodoeosin as an indicator in the titration of the monosodium salt of diethylbarbituric acid (veronal).—Ztschr. analyt. Chem. 1916, v. 55, p. 452–459.

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ACIDUM GALLICUM.

Mito, M.: Methods for the preparation of tannic acid, gallic acid, and pyrogallol are described in detail.—J. Chem. Ind. Tokyo, 1917, v. 20, p. 720–737.

ACIDUM HYDRIODICUM DILUTUM.

Dohme, A. R. L.: The committee on standards and deterioration of the American Drug Manufacturers' Association states that the U. S. P. process for hydriodic acid yields a product which does not meet the incineration test.—Proc. Am. Drug. Mfg. Assoc. 1917, p. 184.

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Tentelev Chemical Works: British patent No. 107312 describes the purification of hydrochloric acid by means of zinc chloride.—Chem. Abstr. 1917, v. 11, p. 3395.

Villiers, A.: A description of a method for the quantitative determination of ammonia and of hydrochloric acid by weighing as ammonium chloride.—Bull. soc. chim. France, 1917, v. 23, p. 306–308.

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ACIDUM HYDROCHLORICUM DILUTUM.

Bachman, G.: Five samples of dilute hydrochloric acid were analyzed. They assayed 6.18, 10.10, 12.70, and 12.80, per cent, respectively.—Proc. Minnesota Pharm. Assoc. 1917, p. 186.

Jackson, Frank A.: The samples of dilute hydrochloric acid examined varied in acid strength from 4.21 to 14.5 per cent. A few of the samples were prepared from commercial hydrochloric acid.—Rep. Rhode Island F. & D. Com. 1917, p. 32.

ACIDUM HYDROCYANICUM DILUTUM.

Anderson, George W.: An investigation to determine the sensitiveness of methods employed for the detection of hydrocyanic acid.—J. Soc. Chem. Ind. 1917, v. 36, p. 195–196.

Kolthoff, I. M.: Researches on the detection and quantitative estimation of small quantities of hydrocyanic acid. A study of analytical methods in current use for cyanogen compounds.—Pharm. Weekblad, 1917, v. 54, p. 1157–1171.

Willaman, J. J.: A discussion of methods in use for the determination of hydrocyanic acid in plant tissues.—J. Biol. Chem. 1917, v. 29, p. 25.

ACIDUM HYPOPHOSPHOROSUM.

Bollinger, C. H.: The fact that the U. S. P., IX, does not provide a test for sulphuric acid in hypophorus acid is regarded as a serious omission. The odor of sulphur compounds developed in certain preparations containing hypophosphorus acid is stated to be very annoying.—Proc. Minnesota Pharm. Assoc. 1917, p. 170.

ACIDUM LACTICUM.

A. R. L.: American manufacturers are having difficulty [illegible] lactic acid of U. S. P. quality. The demand for tech- [illegible]out half the strength of the U. S. P. acid), dark in color

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and unpleasant in odor, is strong enough to take care of the supply, and manufacturers find little incentive to purify it in quantity. Acid of medicinal quality is, in consequence, very difficult to obtain, except in very small lots.—Proc. N. W. D. A. 1917, p. 509.

Anon.: Some of the so-called lactic acid on the market in Spain is a weak solution of citric acid.—Chem. & Drug. 1917, v. 89, p. 877.

Phelps, I. K., and Palmer, H. E.: A first paper on the identification and estimation of lactic acid in biological products.—J. Am. Chem. Soc. 1917, v. 39, p. 136–149.

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Withrow, James R.: A discussion of the sophistication of nitric acid with special reference to the economic aspect of the problem.—J. Ind. & Eng. Chem. 1917, v. 9, p. 771–776.

Schaefer, K.: An optical study of the constitution of nitric acid.—Ztschr. anorg. Chem. 1916, v. 97, p. 285–311.

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ACIDUM NITRICUM DILUTUM, U. S. P., VIII.

Lascoff, J. Leon: It seems strange that, while formulas for the dilution of most important acids are given in the U. S. P. IX, none appears for diluted nitric acid.—Am. Druggist, 1917, v. 65, No. 5, p. 25.

ACIDUM NITROHYDROCHLORICUM DILUTUM.

Casey, F. W.: One sample of diluted nitrohydrochloric acid examined was rejected because it was not U. S. P. in quality.—Bull. Michigan D. & F. Dept. 1917, No. 262–263, p. 13.

ACIDUM OLEICUM.

Dohme, A. R. L.: The committee on standards and deterioration of the American Drug Manufacturers' Association finds it desirable to devise a simple method for the estimation of solid fatty acids in oleic acid. An acid containing stearic acid is desirable for some lines of manufacture.—Proc. Am. Drug. Mfg. Assoc. 1917, p. 184.

Engelhardt, H.: One lot of oleic acid was rejected on account of containing too large a proportion of solid fatty acids.—J. Am. Pharm. Assoc. 1917, v. 6, p. 310.

ACIDUM PHENYLCINCHONICUM.

Rotter, Luise: Notes on the physiological action of atophan and some of its derivatives.—Ztschr. exper. Path. u. Therap. 1917, v. 19, p. 176–197.

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ACIDUM PHOSPHORICUM.

Klein, Friedrich: Instead of the accurate but rather long method for the determination of phosphoric acid given in the U. S. P., titration with normal KOH V. S. and phenolphthalein is recommended as being accurate enough for all practical purposes.—D.-A. Apoth.-Ztg. 1917, v. 38, p. 52.

Shuey, Philip McG.: A study of the volumetric or Pemberton method for determining phosphoric acid, with some experiments showing the influence of temperature and the sulphuric acid radical on results.—J. Ind. & Eng. Chem. 1917, v. 9, p. 367–370.

Smith, J. H.: An experimental study of the estimation of phosphoric acid and phosphates by alkalimetric methods.—J. Soc. Chem. Ind. 1917, v. 36, p. 415–419.

Bauzil: A description of a volumetric method for the quantitative estimation of phosphoric acid.—J. pharm. et chim. 1917, v. 16, p. 321–324.

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Villiers, A.: A criticism of J. Clarens's method for the estimation of P_2O_5 as ammonium phosphomolybdate.—Bull. soc. chim. France, 1917, v. 23, p. 305–306.

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Balareff, D.: Directions are given for the titration of H_3PO_4, $H_4P_2O_7$, and HPO_3 in the same solution with sodium hydroxide, the indicators used being methyl orange, phenolphthalein, and silver nitrate-lacmoid.—Ztschr. anorg. Chem. 1917, v. 99, p. 184–186, through J. Chem. Soc. 1917, v. 112, part 2, p. 506.

Dohme, A. R. L.: One sample of phosphoric acid of commercial quality examined contained an excess of heavy metals and arsenic.—Proc. N. W. D. A. 1917, p. 514.

ACIDUM SALICYLICUM.

Pomilio, U.: British patent No. 103709. A method for the preparation of salicylic acid by the electrolytic oxidation of cresols is described.—J. Soc. Chem. Ind. 1917, v. 36, p. 382.

Dohme, A. R. L.: Several manufacturers have found it difficult to free salicylic acid from organic impurities, which darken it and sometimes impart a phenolic odor. Pure white acid is difficult to obt

N. W. D. A. 1917, p. 509.

. L.: The committee on standards and deterioration

Drug Manufacturers' Association finds it desirable

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to have a method for distinguishing natural from synthetic salicylic acid and salicylates.—Proc. Am. Drug Mfg. Assoc. 1917, p. 184.

Waterman, H. I.: In an investigation of the alkaline acid equivalents of various substances it was found that salicylic acid differs from its isomerides by displaying the properties of a monobasic acid.—Chem. Weekblad, 1917, v. 14, p. 1126–1131.

Tunmann, O.: Reactions for the identification of salicylic acid are described.—Apoth.-Ztg. 1917, v. 32, p. 289–292 and 298–299, through J. Chem. Soc. Lond. 1917, v. 112, part 2, p. 551–553.

Steenbergen, H. D.: An investigation of various methods for the quantitative determination of salicylic acid in foods.—Chem. Weekblad, 1917, v. 14, p. 914–921.

Anon.: A description of a method for the quantitative determination of the combined salicylic acid in acetylsalicylic acid.—Arch. Pharm. Chem. 1917, v. 24, p. 45.

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Roberts, J. G.: Five lots of salicylic acid examined were satisfactory except that they each contained a slight excess of organic impurities.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 78.

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Kling, André: The Gutzeit test is recommended for the detection of arsenic in sulphuric acid, and a convenient form of apparatus for the purpose is described.—Ann. Falsif. 1917, v. 10, p. 451–453.

Palet, Luciano P. J.: A test for the detection of selenium in sulphuric acid is based upon the color produced with aspidospermine.—Anales soc. quim. Argentina, 1917, v. 5, p. 121–123.

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Vulquin, E. and Entat, M.: A method for the detection and estimation of small quantities of free sulphuric acid in the presence of sulphates is outlined.—Ann. chim. analyt. 1917, v. 22, p. 61–66.

For patents relating to the manufacture of sulphuric acid, see Chem. Abstr. 1917, v. 11 and J. Soc. Chem. Ind. 1917, v. 36.

ACIDUM SULPHURICUM AROMATICUM.

Dohme, A. R. L.: The U. S. P. assay process for aromatic sulphuric acid needs revision, as the chemical reaction involved is reversible as long as alcohol is present.—Proc. N. W. D. A. 1917, p. 504.

Jackson, Frank A.: The samples of aromatic sulphuric acid examined fell from a fraction of 1 per cent to 6 per cent below the U. S. P. strength of 20 per cent.—Rep. Rhode Island F. & D. Com. 1917, p. 32.

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Mito, M.: A description of a method for preparing tannic acid, gallic acid, and pyrogallol from Japanese gall nuts.—J. Chem. Ind. Tokyo, 1917, v. 20, p. 720–736.

Lauffmann, R.: A general scheme is given for the identification of the vegetable tannins by the ordinary methods. Methods for distinguishing between the vegetable and synthetic tannins are also described.—Chem. Ztg. 1917, v. 41, p. 273–275, 286–288, through J. Soc. Chem. Ind. 1917, v. 36, p. 513.

Il'in, L. F.: A continuation of experiments to determine the constitution of tannin—Chem. Abstr. 1917, v. 11, p. 3039.

Kobert, R.: The biological detection and evaluation of tannins. The author describes three methods of finding the maximum dilution at which a tannin solution exerts an astringent action, as shown by the coagulation of fresh blood corpuscles.—Chem. Ztg. 1917, v. 41, ref. 12, through J. Soc. Chem. Ind. 1917, v. 26, p. 297.

Balderston, L.: A rough method for the estimation of tannin is based on the precipitation of the latter with gelatin.—J. Am. Leather Chem. Assoc. 1917, v. 12, p. 59–60.

Huerre: Stable tannic acid solutions may be prepared by using sterilized water which has been recently distilled. An abstract.—Presse Medicale, 1917, v. 25, p. 21.

Scoville, W. L.: One lot of tannic acid was rejected on account of its dark color.—J. Am. Pharm. Assoc. 1917, v. 6, p. 310.

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Zwikker, J. J. L.: A discussion of researches tending to show the nonexistence of metatartaric acid.—Chem. Abstr. 1917, v. 11, p. 33.

Br[illegible] A method for the detection of tartaric acid in syrup of len[illegible] Weekblad, 1917, v. 54, p. 686–687.

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ACONITUM.

Achard, H. J.: A study of aconite, including its history, galenical reparations, toxicology, and therapeutic uses.—Am. J. Clin. Med. 917, v. 24, p. 35–37, 192–194, 273–276.

Dohme, A. R. L.: The committee on standards and deterioration f the American Drug Manufacturers' Association finds it desirable o improve the assay method for aconite root, and recommends the limination of extract of aconite from the U. S. P.—Proc. Am. Drug fg. Assoc. 1917, p. 184.

Anon.: In a criticism of the aconite assay, H. Engelhardt states hat physiological experiments show that powdered extract of aconite s almost worthless and that the fluid extract deteriorates very rapidly. The author therefore urges that the assay process for both the owdered extract and fluid extract of aconite be revised, and that ome further work be done in regard to the present assay methods.—Pharm. Era, 1917, v. 50, p. 236–237.

Millard, N. P.: Suggestions for facilitating the computation of the alkaloids in aconite root, aconite tincture, and aconite liniment when assayed according to the methods given in the Ph. Brit. 1914.—Pharm. J. 1917, v. 99, p. 291.

Rippetoe, J. R.: It is stated that experience has shown that methyl red indicator gives a better end point but a somewhat lower result than cochineal in the titration of the aconite alkaloids.—Drug. Circ. 1917, v. 61, p. 501; J. Am. Pharm. Assoc. 1917, v. 6, p. 463.

Dohme, A. R. L.: The aconite assay is misleading and unreliable because its end point is not necessarily aconitine. Methyl red gives a more distinct end reaction, and the results obtained are more nearly in agreement with the physiological tests.—Proc. N. W. D. A. 1917, p. 502.

Pittenger, Paul S.: In the U. S. P. biological method for the standardization of aconite, the proposed "time limit" of 12 hours is too short, since the test consumes at least 13 hours. A 24-hour limit is more desirable, as the 13-hour test can not be completed in the ordinary working day.—J. Am. Pharm. Assoc. 1917, v. 6, p. 869.

Schulze, Heinrich, and Liebner, A.: A report of investigations to determine the constitution of the aconite alkaloids. The paper deals especially with the constitution of the derivatives of aconite, pyraconitine, and pyraconine.—Arch. Pharm. 1916, v. 254, p. 567–583, through J. Chem. Soc. Lond. 1917, v. 112, part 1, p. 470.

Alsberg, C. L.: Examination by the Bureau of Chemistry of samples of aconite obtained in import and interstate trade has disclosed that "Japanese aconite" (*Aconitum fisheri* Reich) has been substituted

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in some instances for *Aconitum napellus* L. A simple method for detecting the adulteration is given.—S. R. A. Chem. 1917, No. 20, p. 56–57.

Dohme, A. R. L.: The few samples of Japanese aconite root examined were found to be low in alkaloidal content as compared with the official drug.—Proc. N. W. D. A. 1917, p. 507.

Roberts, J. G.: One lot of aconite root examined had a low alkaloidal content, a sample from one bag showing 0.35 per cent and from another 0.44 per cent. This was partially due to the fact that the lot was insufficiently dried. However, the lot was of inferior quality, as, after drying, it contained only 0.44 per cent of alkaloids. A trial sample of aconite root containing 0.68 per cent alkaloids was in poor physical condition, as it contained 15 per cent of stems and was about one-third moldy.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 79.

Engelhardt, H.: Of four samples of aconite root examined three were rejected, as they assayed below 0.5 per cent of aconitine.—J. Am. Pharm. Assoc. 1917, v. 6, p. 310.

Dohme, A. R. L.: One lot of aconite root was rejected because it contained about 15 per cent of stems and was about one-third moldy.—Proc. N. W. D. A. 1917, p. 514.

Anon.: Of 12 samples of aconite root assayed, the aconitine content of 10 was above standard and 2 below.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 92.

ADEPS.

Carles, P.: An account of the preparation and purification of lard intended for use as a pomade base.—Répert. pharm. 1917, v. 28, p. 225–226.

Issoglio, Giovanni: Data showing the oxidizability numbers of different samples of lard are given.—Giorn. farm. chim. 1917, v. 66, p. 249.

Arnold, W.: The results obtained in testing 45 samples of lard for foreign fats by the Bömer method are presented and discussed.—Ztschr. Unters. Nahr. u. Genussm. 1916, v. 31, p. 377–381.

Engelhardt, H.: Descriptions of German substitutes for lard, with directions for making the same.—J. Am. Pharm. Assoc. 1917, v. 6, p. 56.

Anon.: A list of formulas for the preparation of substitutes for lard. An abstract.—Schweiz. Apoth.-Ztg. 1917, v. 55, p. 146.

Anon.: Of 75 samples of benzoinated lard examined, 30 were not of U. S. P. standard.—Bull. North Dakota Agric. Exper. Sta., through J. Am. Pharm. Assoc. 1917, v. 6, p. 411.

ADEPS LANÆ.

R. L.: Wool fat of high quality is now obtained. English manufacturers have learned how to purify

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crude fat, and the purified product is entirely satisfactory.—Proc. N. W. D. A. 1917, p. 511.

Anon.: Notes on the preparation and purification of wool fat.—Pharm. Ztg. 1916, p. 620, through Pharm. Weekblad, 1917, v. 54, p. 376.

Salisbury, O. B.: An account of the commercial preparation and purification of wool fat.—Pharm. Era, 1917, v. 50, p. 279–281.

Röhmann, F.: From an investigation of the constituents of wool fat it is concluded that the latter consists of a mixture of the esters of cholesterol and of the alcohols of the fatty series, including ceryl alcohol and alcohols with a smaller number of carbon atoms.—Biochem. Ztschr. 1916, v. 77, p. 298–328, through J. Soc. Chem. Ind. 1917, v. 36, p. 346.

Scoville, W. L.: Wool fat of medicinal quality is hard to obtain. That on the market is usually of dark color, strong in odor, and frequently shows an excess of sulphur compounds.—J. Am. Pharm. Assoc. 1917, v. 6, p. 310.

Roberts, J. G.: All of the lots of wool fat which were of domestic origin were of satisfactory quality, but an improvement in color is desired, as the color is deeper than that usually found in the foreign products.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 79.

Engelhardt, H.: A large shipment of anhydrous wool fat was rejected because the acid number was too high, probably due to the presence of resin. The product had a very sticky consistence and did not readily mix with water.—J. Am. Pharm. Assoc. 1917, v. 6, p. 310.

Dohme, A. R. L.: Eimer and Amend report a case of adulteration of lanolin with 50 to 60 per cent of petrolatum.—Proc. N. W. D. A. 1917, p. 508.

New York committee: Several lots of wool fat examined contained petrolatum and resin.—J. Am. Pharm. Assoc. 1917, v. 6, p. 310.

Engelhardt, H.: A list of German substitutes for wool fat, with directions for preparing the same.—J. Am. Pharm. Assoc. 1917, v. 6, p. 58.

Axelrad, Sol.: Experiments on the preparation of cetylic alcohol and a discussion of its suitability as a substitute for lanolin.—J. Ind. & Eng. Chem. 1917, v. 9, p. 1123–1125.

ADEPS LANÆ HYDROSUS.

Sayre et al.: Two of six samples of hydrous wool fat tested contained an excess of free fatty acid.—Rep. Kansas Bd. Health, 1917, v. 13, p. 169.

ÆTHER.

Dohme, A. R. L.: The committee on standards and deterioration of the American Drug Manufacturers' Association finds it desirable

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to devise tests for ether to be used for anesthesia.—Proc. Am. Drug Mfg. Assoc. 1917, p. 184.

Dott, B. B.: A criticism of the Ph. Brit. fuchsin test for methyl compounds in ether. It is stated that specific directions should be given for preparing the fuchsin solution, and that the oxalic-acid solution should be made one-half the specified strength.—Pharm. J. 1917, v. 98, p. 236; see also v. 99, p. 283, and Chem. & Drug. 1917, v. 89, p. 1060.

Schenk, D.: The observations of Herzog with respect to ether for narcosis are confirmed. It is suggested that, in the case of negative results with the KOH test of Ph. Germ., it be repeated after the ether has been reduced by evaporation to two-thirds or one-half the original volume.—Apoth.-Ztg. 1916, v. 31, p. 290–291, through Chem. Abstr., 1917, v. 11, p. 1719.

Perkins, R. L.: A process for the estimation of alcohol and water in ether intended for use as an anesthetic is described. The method differs from that of Mallinckrodt and Alt, in that the water is estimated from the specific gravity of the original mixture.—J. Ind & Eng. Chem. 1917, v. 9, p. 521–523.

Lyons, A. B.: A description of a method for computing the alcohol and water content of ether from the specific gravity of the mixture.—J. Am. Pharm. Assoc. 1917, v. 6, p. 553–554.

Lyons, A. B.: A supplemental note on the testing of ether.—J. Am. Pharm. Assoc. 1917, p. 716.

van Leeuwen, W. Storm: A discussion of data obtained in the physiological standardization of narcotics.—Pharm. Weekblad, 1917, v. 54, p. 1470–1479.

McCardie, W. J.: A report of experiments to determine the most satisfactory mixture of ether and chloroform for use in war surgery.—Brit. M. J. 1917, v. 1, p. 508.

ÆTHYLMORPHINÆ HYDROCHLORIDUM.

Sanchez, Juan A.: Three tests for the identification of dionine are described.—Rev. farm. 1917, v. 60, p. 699.

AGAR.

Farwell, Oliver Atkins: The definition for agar should be corrected to exclude species of *Gracilaria* and *Gloiopeltis* as sources of origin of agar. Furthermore, "Fam. *Gelidiaceæ*" should be used instead of "Class *Rhodophyceæ*."—Drug. Circ. 1917, v. 61, p. 173.

Takao, Y.: *Gelidium Amansii, G. Japonicum, G. Pacificum, G. subcostatum*, and *Ptercotadia capillaceum* are the algæ which are exported from Formosa for the preparation of agar-agar. *Gelidium Amansii* yields the best agar-agar. The others give a product of [illegible]ity and may be looked upon as adulterants.—J. pharm. [illegible]7, v. 15, p. 175; see also Pharm. J. 1917, v. 98, p. 257.

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Fellers, Carl R.: Some notes on the composition of agar, its properties and use as a jellifying medium.—Pure Products, 1917, v. 13, p. 177–185.

Fellers, C. R.: A report of bacteriological studies of agar-agar.—Soil Science, 1916, v. 2, p. 255–290, through Physiol. Abstr. 1917, v. 2, p. 630.

Brown, Orville H. and Sweek, William O.: A note on the use of liquid agar in the treatment of constipation.—J. Am. M. Assoc. 1917, v. 69, p. 467–468.

AGARICUS, N. F.

Farwell, Oliver Atkins: The proper designation for agaricus under *Polyporus* is *Polyporus Laricis* (Jacq.) Scopoli.—Drug. Circ. 1917, v. 61, p. 229.

Rusby, H. H.: What is more active or more definite in action than agaricin, or what can be handled therapeutically better? Agaricus is in the N. F.; why shouldn't agaricin be in the U. S. P.?—Pract. Drug. 1917, v. 35, No. 3, p. 27.

McCartney, Ethel: A pharmacological study of agaricin.—J. Pharmacol. & Exper. Therap. 1917, v. 10, p. 83–94.

ALCOHOL.

Stein, Leo: A short paper giving an account of the manufacture of alcohol.—Pure Products, 1917, v. 13, p. 186–190.

Thatcher, F., and Stiles, L. M.: German patent No. 291073 describes a method for the preparation of alcohol from cactus plants.—Chem. Abstr. 1917, v. 11, p. 1248.

Anon.: A method for the preparation of alcohol from calcium carbide is described. The calcium carbide is hydrolized and the resulting acetylene oxidized to acetic aldehyde, which is finally reduced to alcohol by means of hydrogen. An abstract.—Giorn. farm. chim. 1917, v. 66, p. 315–316.

Lebedev, Alexandre: Researches to determine if lactic acid is an intermediate product in alcohol fermentation.—Biochem. J. 1917, v. 11, p. 189–196.

Popesco: A description of a method for decolorizing alcohol which has been stored in iron containers.—Pharm. Zentralh. 1916, p. 693, through Schweiz. Apoth.-Ztg. 1917, v. 55, p. 419.

Vaughan, Victor C.: Tests for determining the purity of alcohol intended for use in work on protein poisons are described.—J. Lab. & Clin. Med. 1916–1917, v. 2, p. 57–58.

Reid, E. Emmet: Identification of alcohols. The method consists in converting the alcohol into the acid phthalate, treating the sodium salt of the latter with p-$O_2NC_6H_4CH_2Br$, and isolating the resulting alkyl nitrobenzyl phthalate.—J. Am. Chem. Soc. 1917, v. 39, p. 1249–1255.

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Aronstamm, George C.: Notes on various methods for determining the alcoholic content of medicinal preparations.—Bull. Pharm. 1917, v. 31, p. 26–28.

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all but 1,537 were for syphilis. The preparations used were neosalvarsan, novarsenobenzol, salvarsan and arsenobenzol, galyl, and luargol. No fatal case was reported among the 95,000 injections, although in some cases toxic symptoms were observed.—Pharm. J. 1917, v. 98, p. 176.

Lockenmann, Gorg: A report of investigations on the excretion of arsenic in the human urine after injection of different preparations (arsacetin, atoxyl, arsenophenylglycine, salvarsan, and neosalvarsan).—Biochem. Ztschr. 1916, v. 78, p. 1–36, through J. Chem. Soc. Lond., 1917, v. 112, part 1, p. 495.

Sieburg, Ernst: A study of the fate of arsenic compounds in the body.—Ztschr. physiol. Chem. 1916, v. 97, p. 53–108 through Zentralb. Biochem. u. Biophys. 1917, v. 19, p. 157–160.

Ormsby, Oliver S.: A discussion of the use of salvarsan and neosalvarsan in the treatment of syphilis.—J. Am. M. Assoc. 1917, v. 68, p. 949–954.

Danysz, J.: The physicochemical properties of the compounds of the arsenobenzene groups. I. A study of the transformation of these compounds in the organism.—Ann. inst. Pasteur, 1917, v. 31, p. 114–137.

Danysz, J.: From experiments with rabbits it is concluded that the injection of luargol is followed by the production of an antibody. In the author's opinion there is a complete identity of the reactions between the serums and arsenobenzenes, and between the serums and biologic antigens.—Compt. rend. Acad. sc. 1917, v. 164, p. 746–748.

Dalimier, R.: Notes on the use of luargol in therapeutics.—Ann. inst. Pasteur, 1917, v. 31, p. 492–516.

Yakinoff, W. L., and Wassilevsky, W. J.: A report of some biological tests with luargol. Results obtained in the treatment of experimental dourine in mice are reported.—Compt. rend. soc. biol. 1917, v. 80, p. 387–388.

Anon.: Since quite a number of cases of salvarsan poisoning, resulting in partial paralysis, blindness, and even death, have occurred in the clinics of several large universities in Germany, the Reichbote believes that statistical data concerning all cases of poisoning by this drug occurring in the Empire should be published by the Government in order to warn against the indiscriminate use of the remedy.—Drug. Circ. 1917, v. 61, p. 244.

Pearce, Louise, and Brown, Wade H.: An investigation of the toxicity of salvarsan and neosalvarsan. The toxicity of both substances was found to be quite irregular, the greater irregularities being observed with neosalvarsan.—J. Pharmacol. 1917, v. 9, p. 354–355.

McCaskey, G. W.: A report of a fatal case of salvarsan and neosalvarsan myelitis.—J. Am. M. Assoc. 1917, v. 69, p. 1960–1962.

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Armsby and Mitchell: A report on the toxicity of the present supply of salvarsan and neosalvarsan. . Recent shipments were found to be more toxic than the stocks on hand.—West Virginia M. J. Jan. 1917 through Therap. Gaz. 1917, v. 41, p. 437.

Arsphenamine.—Editorial: Hereafter salvarsan will be manufactured in this country under the name of arsphenamine. It will be prepared according to German patents by three manufacturers in the United States—namely, the Dermatological Research Laboratories, of Philadelphia; the Takamine Laboratory (Inc.), of New York; and the Farbwerke-Hoechst Co. (Herman R. Metz Laboratory), of New York.—Am. Druggist, 1917, v. 65, No. 12, p. 22.

Anon.: A report of the hearing which the Committee on Patents of the United States Senate gave on June 4 on the several bills now pending in Congress, looking toward the abrogation or suspension of of the patents controlling the manufacture of salvarsan, or the assumption of ownership or trusteeship by the Government.—J. Am. M. Assoc. 1917, v. 68, p. 1706–1707.

Anon.: The rector of a German university recently stated that while the cost of manufacturing a kilogram of salvarsan did not exceed 8 marks, or about $2, the drug was sold at 16,000 marks ($3,808).—Chem. Eng. 1917, v. 25, p. 143.

Rules and standards prescribed by the United States Public Health Service for the manufacture of arsphenamine.—Public Health Rep. 1917, v. 32, p. 2071–2072.

Bunch, J. L.: Short descriptions of salvarsan and its substitutes are given.—Practitioner, 1917, v. 98, p. 279–286.

Anon.: At the annual meeting of the National Academy of Sciences Dr. Simon Flexner, of the Rockefeller Institute, announced that two American physicians (Drs. Jacobs and Heidelberger, of the Rockefeller Institute) have evolved a new remedy to replace salvarsan. The new discovery is an arsenic compound and is called "A–189."—Oil, Paint & Drug Rep. 1917, v. 92, No. 23, p. 21.

Dohi, K., et al.: A comparison of Japanese salvarsan preparations with the original product of Ehrlich. The toxicity of all preparations was notably less than that of the German product.—Chem. Abstr. 1917, v. 11, p. 2934.

Hirano: From experiments it is concluded that arsaminol should be just as effective as salvarsan, but that further observations will be necessary to establish its limits of toxicity. Arsaminol was found to be less soluble than salvarsan.—Chem. Abstr. 1917, v. 11, p. 2370.

Ivanov, V. V.: Experiments with the Russian preparation made by [illegible] and Kucher and named arsenol, and another preparation [illegible] reschefsky and called benzarsan, proved that they are [illegible] ho Ehrlich's 606.—Russki Vratch, 1916, p. 1088 through [illegible] 917, v. 11, p. 866.

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Anon.: A note calls attention to the adulteration of salvarsan in Sweden. One of the samples obtained in Stockholm was found to consist of a mixture of barium chromate, barium sulphate, and potassium sulphate. A second sample examined consisted of lycopodium, sodium chloride, and ocher.—Schweiz. Apoth.-Ztg. 1917, v. 55, p. 239.

Lissauer, Max: Some notes on death due to salvarsan.—Deutsch. med. Wchnschr. 1917, v. 43, p. 1471–1472.

Lowrey, Lawson G.: A report of a case of pernicious anemia in a syphilitic treated with salvarsan.—Boston M. & S. J. 1917, v. 177, p. 52–53.

Vassallo: Two cases of sudden death after the administration of kharsivan are reported. An abstract.—Therap. Gaz. 1917, v. 41, p. 743.

Wadia, Manneck D.: A report of a case of death after the administration of salvarsan.—Brit. M. J. 1917, v. 1, p. 13–14.

Cazamian: A report of a case of icterus of hepatic origin due to salvarsan.—Arch. med. et pharm. nav. 1917, v. 103, p. 46–62.

Rowlands, M.. J. An illustrated description of an apparatus for the intravenous injection of salvarsan.—Practitioner, 1917, v. 99, p. 199–200.

Stoner, Willard C.: A clinical report on the intraspinal treatment of neurosyphilis with standardized salvarsanized serum.—J. Am. M. Assoc. 1917, v. 68, p. 610–611.

Jones, Lloyd, and Gibson, A. J.: A report of 200 cases of syphilis treated with salvarsan.—Brit. M. J. 1917, v. 1, p. 152–154.

Neoarsphenamine.—Harrison, L. W. et al: A report on the treatment of syphilis by intramuscular or subcutaneous injection of neosalvarsan.—Brit. M. J. 1917, v. 1, p. 569–571.

Balzer, F., and Beauxais-Lagrave, R.: A method for the preparation of a glucose solution of novarsenobenzol suitable for intramuscular injections.—L'Union pharm. 1917, v. 58, p. 177, through Year-Book of Pharmacy, 1917, p. 259.

Zeisler, E. P.: A report of 10 cases in which bad effects followed the administration of neodiarsenol.—J. Am. M. Assoc. 1917, v. 69, p. 2181.

Shields, C. L.: Out of 23 patients injected with neoarsphenamine, four exhibited severe symptoms of poisoning and one died. The observance of toxic symptoms by other physicians is also reported.—J. Am. M. Assoc. 1917, v. 68, p. 53.

ARSENI TRIOXIDUM.

Asher, Philip: An explanation of the chemistry of the U. S. P. assay for arsenic trioxide.—Am. J. Pharm. 1917, v. 89, p. 166.

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McNally, William D.: Data showing the equivalents in grams of arsenic trioxide found per 100 grams of tissue of the various organs nine days after death.—J. Am. Chem. Soc. 1917, v. 39, p. 826–828.

Schreinemakers, F. A. H., and DeBaat, Mej. W. C.: A discussion of experiments on the combination of arsenious acid anhydride with various salts. Data bearing on the combinations formed are presented.—Chem. Weekblad, 1917, v. 14, p. 141–146, 203–208, 244–248.

Roberts, J. G.: One lot of arsenic trioxide examined was of decidedly inferior quality. It was only 98.14 per cent pure, and failed to give satisfactory results with the U. S. P. ammonia-water test, the arsenous sulphide test, the antimony-tin-cadium test, and yielded 1 per cent of residue after sublimation.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 80.

Davis, Benjamin F.: A report of two cases of perforation of the nasal septum due to the inhalation of arsenic trioxide.—J. Am. M. 1917, v. 68, p. 1620–1621.

ASAFŒTIDA.

Rusby, H. H.: Asafetida is now almost always of good quality. The standards which were worked out by the United States Bureau of Chemistry, and which were submitted to so much criticism by certain English chemists, have been fully justified.—J. Am. Pharm. Assoc. 1917, v. 6, p. 310.

Merrill, E. C.: Referee report on the analysis of asafetida. Qualitative tests are described and data obtained in the application of these tests and in the determination of the lead number are presented.—J. Assoc. Off. Agric. Chem. 1916, v. 2, p. 82–87.

Dohme, A. R. L.: The quality of asafetida, especially as to ash content, was better than in former years.—Proc. N. W. D. A. 1917, p. 507.

E'wo, G. E.: All lots of asafetida examined during the past year were satisfactory in alcohol-soluble matter content.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 81.

Patch, E. L.: A sample of powdered asafetida yielded 53.5 per cent of alcohol-soluble constituents and 20 per cent of ash.—J. Am. Pharm. Assoc., 1917, v. 6, p. 310.

Scoville, W. L.: Eleven samples of asafetida ranged from 32.76 per cent soluble in alcohol and 37.46 per cent of ash to 76.4 per cent soluble in alcohol and 6.6 per cent of ash. Eight samples contained more than 64 per cent of material soluble in alcohol, and, with one exception, less than 8 per cent of ash.—J. Am. Pharm. Assoc. 1917, v. 6, p. 310.

Rol[illegible] J. G.: Of eight lots of asafetida examined, six were adulter[illegible] Pennsylvania Pharm. Assoc. 1917, p. 80.

[illegible]ne of two samples of asafetida tested was adulter[illegible] [illegible]sas Bd. Health, 1917, v. 13, p. 173.

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ASARUM, N. F.

Farwell, Oliver Atkins: "Snakeroot" is the most generally accepted way of writing the word "snake-root," appearing in the N. F., IV.—Drug. Circ. 1917, v. 61, p. 229.

ASPIDIUM.

Farwell, Oliver Atkins: The oldest post-Linnæan generic name for the male fern is *Filix* (Fuchs) Hill. The proper combinations for the species designated are, therefore, *Filix Filix-mas* (Lin.) Farwell and *Filix marginalis* (Lin.) Farwell.—Drug. Circ. 1917, v. 61, p. 173.

Dohme, A. R. L.: There is very little of the official *Aspidium Filix-mas* gathered in this country. The material is of a different species, and is generally unpeeled, and therefore in such a condition that it can not be used.—Proc. N. W. D. A. 1917, p. 513.

Anon.: A book review calls attention to a reprint from the Eighteenth Annual Report of the Michigan Academy of Science, December, 1916, entitled *Fern Notes*.—Pharm. Era, 1917, v. 50, p. 124.

ASPIDOSPERMA.

Farwell, Oliver Atkins: The hyphen between *Quebracho* and *blanco* has been omitted in the U. S. P., IX. This is doubtless a typographical error.—Drug. Circ. 1917, v. 61, p. 174.

Rippetoe, J. R.: An alkaloidal standard should be established for aspidosperma and its fluid extract. A good quality of drug should contain at least 1 per cent of chloroform-soluble alkaloids when assayed by the method for cinchona.—Drug. Circ. 1917, v. 61, p. 501. See also J. Am. Pharm. Assoc. 1917, v. 6, p. 463.

Dohme, A. R. L.: One sample of quebracho examined was composed entirely of wood.—Proc. N. W. D. A. 1917, p. 520.

Anon.: The alkaloidal content of 1 sample of quebracho assayed was above standard.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 92.

ATROPINA.

Arny, L. W.: A report on the value of selecting belladonna plants as a factor for increasing the atropine content. The external characters of the plant appear to be an index of alkaloidal content.—Am. J. Pharm. 1917, v. 89, p. 254–257.

Von Weisse, G. and Meyer, Levy: The ionization constant of atropine calculated from the neutralization and displacement curves is 1.7 x 10–12.—J. chim. phys. 1916, v. 14, p. 261–284.

Rasmussen, H. B.: A description of an exact method for the quantitative determination of atropine. The alkaloid is precipitated by means of silicotungstic acid.—Arch. Pharm. Chem. 1917, v. 24, p. 83–86, 110–113; Pharm. Weekblad, 1917, v. 54, p. 1458–1459.

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Bellows, Howard P.: A study of atropine with particular reference to the proving of alkaloids.—J. Am. Inst. Homoeop. 1917, v. 9, p. 808–814.

AURANTII AMARI CORTEX.

Farwell, Oliver Atkins: Why any varietal or subspecific name should be used in describing bitter orange is a question that has not been explained. The bitter orange (*Citrus vulgaris* Risso, *Citrus Bigaradia* Loisel, and *Citrus Aurantium amara*) is the exact type of the Linnæan *Citrus Aurantium*. No further designation is necessary.—Drug. Circ. 1917, v. 61, p. 174.

AURANTII DULCIS CORTEX.

Farwell, Oliver Atkins: It is suggested that it would be better to consider the sweet orange mentioned in the U. S. P. as a distinct species under the name *Citrus Sinensis* (Lin.) Osbeck.—Drug. Circ. 1917, v. 61, p. 174.

BALSAMUM PERUVIANUM.

Rippetoe, J. R.: In the U. S. P. assay for cinnamein it is directed that the residue be dried to constant weight at 100° C. This can not be done, since its boiling point is between 225° and 235° C. The ether should be allowed to evaporate at room temperature or gentle heat, and the residue dried in a vacuum desiccator over sulphuric acid.—Drug. Circ. 1917, v. 61, p. 501; J. Am. Pharm. Assoc. 1917, v. 6, p. 463.

BALSAMUM TOLUTANUM.

Patch, E. L.: One sample of balsam of Tolu examined contained 9.8 per cent of inert material insoluble in alcohol and an excess of moisture.—J. Am. Pharm. Assoc. 1917, v. 6, p. 310.

BELLADONNÆ FOLIA.

Arny, L. Wayne: Observations on the breeding of belladonna to increase the alkaloidal content.—Mulford's Vet. Bull. 1917, v. 8, p. 67–70; Am. J. Pharm. 1917, v. 89, p. 254–257.

Sievers, A. F.: A report of experiments in the selection of belladonna seeds with special reference to the power of germination.—Am. J. Pharm. 1917, v. 89, p. 203–213.

Schneider, Albert: A comprehensive report on the cultivation of belladonna in California.—Pacific Pharm. 1917, v. 11, p. 161–165, 187–192.

Tunmann, O.: A note on some new adulterants of belladonna leaves. Phytolacca, ailanthus, and plantago are mentioned.—Apoth.-Ztg. [illegible] 181, through Pharm. Weekblad, 1917, v. 54, p. 1427.

[illegible]: Examination of samples of importations of "bella [illegible] by the Bureau of Chemistry has revealed that *Solanum*

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nigrum L. has been substituted in some instances for the true material.—S. R. A.-Chem. 1917, No. 20, p. 58.

Dohme, A. R. L.: The roots and foliage of the common nightshade, *Solanum nigrum* Lin., are being largely gathered and offered for belladonna. This plant contains solanine.—Proc. N. W. D. A. 1917, p. 511.

Dohme, A. R. L.: All samples of belladonna leaves examined were of first-class quality. Domestic leaves were superior to the imported and some assayed as high as 0.7 per cent of total alkaloids.—Proc. N. W. D. A. 1917, p. 507.

Engelhardt, H.: One of the 12 samples of belladonna leaves examined met the requirements of the U. S. P. The alkaloidal content ranged from 0.3 to 1.0 per cent.—J. Am. Pharm. Assoc. 1917, v. 6, p. 310.

Patch, E. L.: Five samples of belladonna leaves assayed 0.37, 0.46, 0.28, 0.238, and 0.35 per cent, respectively, of total alkaloids.—J. Am. Pharm. Assoc. 1917, v. 6, p. 310.

Roberts, J. G.: Eight lots of belladonna leaves examined were of U. S. P. quality and contained total alkaloids ranging from 0.41 per cent to 0.67 per cent. Two samples of domestic, cultivated leaves examined were in good condition.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 81.

Scoville, W. L.: Six lots of belladonna leaves examined assayed from 0.30 to 0.52 per cent of alkaloids.—J. Am. Pharm. Assoc. 1917, v. 6, p. 310.

Dohme, A. R. L.: Five samples of belladonna leaves, native stock, examined yielded 0.55 per cent, 0.63 per cent, 0.425 per cent, 0.32 per cent, and 0.62 per cent of mydriatic alkaloids, respectively.—Proc. N. W. D. A. 1917, p. 509.

Anon.: Of nine samples of belladonna leaves assayed, the mydriatic alkaloidal content of eight was above standard and one below.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 92.

BELLADONNÆ RADIX.

Holmes, E. M.: Notes on commercial belladonna obtained from India. The appearance of the root is somewhat different from that of *Atropa Belladonna*, and the character of its alkaloids should be determined before it is accepted as a substitute for the official product.—Pharm. J. 1917, v. 98, p. 351.

Eder, R.: The author describes the methods which he used in distinguishing belladonna from helenium root in a forensic case.—Schweiz. Apoth.-Ztg. 1917, v. 55, p. 132–133.

Dohme, A. R. L. The quality of all 15 shipments of belladonna root examined met the U. S. P. standard.—Proc. N. W. D. A. 1917, p. 507.

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Engelhardt, H.: Four samples of belladonna root were rejected for being low in alkaloidal content. They assayed from 0.4 to 0.445 per cent of total alkaloids.—J. Am. Pharm. Assoc. 1917, v. 6, p. 310.

Roberts, J. G.: One sample of domestic, cultivated belladonna root examined yielded 0.52 per cent of total alkaloids. It was composed of clean, dry root, both split and whole.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 81.

Anon.: Of seven samples of belladonna root assayed, the mydriatic alkaloidal content of five was above standard and two below.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 92.

BENZALDEHYDUM.

Anon.: A description of a method for preparing benzaldehyde from toluene.—Perf. & Ess. Oil Rec. 1917, v. 8, p. 153–154.

Anon.: An article of a general nature dealing with the manufacture of benzaldehyde.—Chem. Trade J. 1917, v. 61, p. 461, through Chem. Abstr. 1918, v. 12, p. 475.

Salamon, M. S.: A description of a method for the estimation of chlorine in synthetic benzaldehyde based on that of Vaubel is described.—Perf. & Ess. Oil Rec. 1917, v. 8, p. 41–42.

BENZINUM PURIFICATUM.

J. G. P.: A review of a volume by N. Strache on the production, properties, and storage of benzine.—Chem. Weekblad, 1917, v. 14, p. 73.

Rittman et al: The physical and chemical properties of gasolines sold throughout the United States during 1915.—Bur. Mines Tech. Paper, 1916, No. 163, p. 1–45.

Dean, E. W., and Hill, H. H.: An investigation of the Hanus iodine method, the sulphuric acid absorption method, the acid heat test, and the bromine absorption method for the determination of unsaturated hydrocarbons in gasoline.—Bur. Mines Tech. Papers, 1917, No. 181, p. 3–22.

Formánek, Jaroslav, et al.: Various tests for the purity of petroleum ether are described. Among them are tests for benzene and turpentine.—Chem.-Ztg. 1917, v. 41, p. 713–714 and 730–731 through J. Chem. Soc. Lond. 1917, v. 112, part 2, p. 581.

Coste, J. H.: An investigation of the inflammability of petroleum spirit at low temperatures.—Analyst, 1917, v. 42, p. 168–170.

Böhme, A., and Köster: A report of clinical and experimental observations on benzine poisoning.—Arch. exper. Path. u. Pharmakol. 1917, v. 81, p. 1–14.

BENZENE (NONOFFICIAL).

[illegible]h, L.: The surface tension of benzene by the capillary [illegible]d was found to be 26.9 dynes/cm., and by the use of the

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author's capillary plate apparatus 28.3 dynes/cm.—Beibl. Ann. Physik. 1916, v. 40, p. 261–262, through Chem. Abstr. 1917, v. 11, p. 1066.

Wilson, J. A.: British patent No. 14152. A method for removing carbon disulphide from benzene by means of sodium or potassium hydroxides is described.—Chem. Abstr. 1917, v. 11, p. 703.

Weiss, J. M.: U. S. patent No. 1205962 describes the purification of benzene by mixing with an aqueous solution of copper sulphate (1–3 pounds of copper sulphate to 100 gallons of hydrocarbon) and distilling.—Chem. Abstr. 1917, v. 11, p. 300.

Moss and Simon Carves By-Product Coke Oven Construction and Working Co.: British patent No. 10066 describes the purification of benzene by passing the vapors through sulphuric acid and subsequently through caustic alkali solution.—Chem. Abstr. 1917, v. 11, p. 95.

Schmitz, E.: A detailed description of a method for the detection of benzene in forensic analyses.—Pharm. Weekblad, 1917, v. 54. p. 1316.

Simonds, J. P., and Jones, H. M.: A study of the effect of intravenous injections of benzene upon the production of antibodies.—J. Med. Res. 1915, v. 33, p. 197–211.

Winslow, F. S., and Edwards, W. D.: Notes on a case of leukemia with some observations on the administration and dosage of benzene.—Presse méd. 1917, v. 25, p. 153; J. Am. M. Assoc. 1917, v. 68, p. 1511.

BENZOINUM.

Coffignier, Ch.: Quantitative analytical data relative to the constituents of benzoin are given.—Rev. chim. industrielle, 1917, v. 26, p. 177.

Roberts, J. G.: Four samples of benzoin (Sumatra) examined under the U. S. P., IX, requirements contained 69.52, 76.23, 76.94, and 75.06 per cent, respectively, of alcohol-soluble matter.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 82.

BENZOSULPHINIDUM.

Beyer, Oskar: A review of the chemistry and physiology of saccharin and disaccharin.—Helvetica Chim. Acta. 1917, v. 1, p. 67–71.

Raimon, Marcel: A discussion of methods which may be employed for the production of saccharin on a commercial scale. The properties, methods of purification, and physiological action of saccharin are also discussed.—Giorn. farm. chim. 1917, v. 66, p. 5–13.

Helch, Hans: A comparison of the sweetening power of saccharin and sugar solutions. The syrup equivalents of different concentrations of saccharin are given. Schweiz. Apoth. Ztg. 1917, v. 55, p. 239.

Merl, Th., and Lüft, K.: A description of a method for the determination of sulphur in saccharin. The compound is oxidized with

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a 15 per cent solution of hydrogen dioxide in the presence of a catalizing agent.—Ztschr. Unters. Nahr. u. Genussm. 1917, v. 33, p. 384 through Pharm. Weekblad, 1917, v. 54, p. 1287–1288.

Repetto, Ernesto: A review of colorimetric and other methods for the determination of saccharin in syrups and other medicinal preparations.—Rev. Farm. 1917, v. 60, p. 407–419.

Klostermann, M., and Scholta, K.: Descriptions of methods for the detection of saccharin.—Ztschr. Unters. Nahr. u. Genussm. 1916, p. 67 through Pharm. Weekblad, 1917, v. 54, p, 305–307.

Bonis, A.: Descriptions of practical methods for the detection and estimation of saccharin in foodstuffs.—Ann. Falsif. 1917, v. 10, p. 210–218.

Gloor, F.: One lot of saccharin examined was found to be the sodium salt of saccharin.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 90.

Burge, W. E.: A note on the food value of saccharin and its use as a substitute for sugar.—Science, 1917, v. 48, p. 549–550.

BETANAPHTHOL.

Stortenbeker, W.: A report of investigations to determine the crystalline form of the two naphthols.—Ztschr. Kryst. Min. 1916, v. 55, p. 373–374 through J. Chem. Soc. Lond. 1917, v. 112, part 1, p. 557.

Ratayama and Ikeda: Betanaphthol is identified by the appearance of a violet color when several drops of concentrated sulphuric acid and a drop of 0.01 per cent sodium nitrate solution are added to a dilute solution containing this compound.—Giorn. farm. chim. 1916, v. 65, p. 225.

Denigés, G.: A description of a method for distinguishing between the two naphthols. An intense green coloration is obtained when a small quantity of α-naphthol is mixed with a solution of titanic acid in concentrated sulphuric acid, whereas β-naphthol gives a blood-red coloration with this reagent.—Ann. chim. analyt. 1916, v. 21, p. 216–217.

Guglialmelli, Luis: α-naphthol may be distinguished from β-naphthol by means of sodium arsenotungstate. α-naphthol gives an intense blue coloration with this reagent, while β-naphthol does not produce a color change.—Anal. soc. quim. Argentina, 1917, v. 5, p. 97–101; also J. Chem. Soc. Lond. 1917, v. 112, part 2, p. 547.

E'we, G. E.: One lot of betanaphthol examined was dark in color, due to tarry matter, and was, therefore, not completely soluble in ammonia water.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 82.

BISMUTHI SUBNITRAS.

Luce, E.: A description of a method for the determination of nitric acid in bismuth subnitrate. The method is a modification of that of Debourdeaux.—Bull. soc. chim. France, 1917, v. 23, p. 264–271.

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Tice, William G.: One sample of bismuth subnitrate examined was below standard.—Rep. New Jersey Dept. Health, 1917, p. 62.

Anon.: A note calls attention to the incompatibility of bismuth subnitrate with sodium hypophosphite if dispensed in powder papers which do not exclude moisture.—Rev. Farm. 1917, v. 60, p. 438.

Phillips, J.: A report of three cases of bismuth poisoning due to the administration of bismuth subnitrate in various forms.—Cleveland Med. J. 1917, v. 16, p. 419.

Editorial: A short article discussing poisoning by bismuth salts.—Lancet, 1917, v. 193, p. 249.

BROMUM, N. F.

Anon.: The output of bromine in the United States during 1915 amounted to 855,857 pounds.—Chem. & Drug. 1917, v. 89, p. 497.

Reiman, Clarence K.: A revision of the atomic weight of bromine based on the normal density of hydrobromic acid gas. The value found was 79.924.—J. chim. phys. 1917, v. 15, p. 334–359. See also Wallace J. Murray, ibid. p. 293–333.

Winkler, L. W.: In an article on the iodine content of Stassfurt sylvite and carnallite, a method for the detection of iodine in crude bromine is described.—Ztschr. angew. Chem. 1916, v. 29, part 1, p. 342–343.

Denigès, G., and Chelle, L.: A description of a modification of the technique for the detection and quantitative estimation of bromine ionized by fuchsine-sulphuric acid reagent.—Bull. Soc. pharm. Bordeaux, 1917, v. 55, p. 75–77.

Pellegrini, Rinaldo: In a note on death by asphyxia from deleterious gases, it is stated that prolonged inhalation of bromine vapor produces marked physiological alterations in the thyroid.—Arch. farm. sper. 1917, v. 23, p. 201–205.

Prins, H. J.: First aid for laboratory injuries. For bromine and chlorine vapors, inhale a mixture of ethyl alcohol and turpentine. For bromine burns, wash with a mixture of 1 vol. 25 per cent ammonia water, 1 vol. turpentine, and 10 vols. of 96 per cent alcohol.—Chem. Weekblad, 1917, v. 14, p. 646–647.

BUCHU.

Alsberg, C. L.: The Bureau of Chemistry calls attention to the fact that samples labeled "long," "short," and "oval" buchu leaves have been found to consist of unofficial species in some instances. The "long buchu" proved to be *Empleurum serratulatum* Sol. et Ait.; the "short buchu" was identified as *Barosma pulchellum* Bartling and Wendland; and the "oval buchu" was identified as *Barosma crenulata* Hook. var. *latifolia*.—S. R. A.–Chem. 1917, No. 20, p. 58.

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CACAO PRÆPARATA.

Hanausek, T. F.: Notes on the microscopical detection of shells in powdered cocoa.—Pharm. Post, 1917, v. 50, p. 369–370.

Huss, H.: A description of the Congo red-brilliant blue method for the microscopical detection of cacao shells. The method is based on the recognition of the mucilage cells under the microscope by means of the stain mentioned.—Ztschr. Unters. Nahr. u. Genussm. 1916, v. 32, p. 404–407.

Beythein, A., and Pannwitz, P.: A comprehensive review of the methods employed for the detection of cacao shells in cacao products.—Ztschr. Unters. Nahr. u. Genussm. 1916, v. 31, p. 265–281.

Rocques, X.: Notes on the determination of the alkalinity of different brands of cacao, and on the analysis of the alkaline reacting substances present.—Ann. Chim. analyt. 1917, v. 22, p. 201–204.

Arpin: A report of investigations to determine the alkalinity of cocoa.—Ann. falsif. 1917, v. 10, p. 10.

Keller: A report of investigations to determine the fat in cocoa.—Apoth. Ztg. 1916, v. 31, p. 330, through J. Soc. Chem. Ind. 1917, v. 35, p. 98.

Débourdeaux, Léon: A description of a method for the quantitative determination of theobromine in cacao.—J. pharm. et chim. 1917, v. 15, p. 306–311.

CACTUS GRANDIFLORUS, N. F.

Farwell, Oliver Atkins: The proper botanical name for night-blooming cereus is *Selenicereus grandiflorus* (Lin.) Britton and Rose. The names given in the N. F., IV, are only synonyms and should not be used.—Drug. Circ. 1917, v. 61, p. 229.

CAFFEINA.

Bartlett, J. M.: In view of the results obtained by five collaborators in the determination of caffeine in tea and coffee, the referee for 1915 recommended that a modified Stahlschmidt method be provisionally adopted by the Association of Official Agricultural Chemists.—J. Assoc. Off. Agric. Chem. 1917, v. 3, p. 33–38.

Palet, L. P. J.: The earlier analyses of maté by Stenhouse are criticized, as the caffeine content was reported as being only 0.13 per cent. The author finds the figure to be nearer 1.2 per cent.—Anales soc. quim. Argentina, 1917, v. 5, p. 92.

Emery, W. O.: A method for the estimation of caffeine, acetanilid, and codeine sulphate in mixtures containing the three substances is described.—J. Assoc. Off. Agric. Chem. 1916, v. 2, p. 72–73.

E[illegible] O.: A description of a method for the estimation of c[illegible]ilid, quinine, and morphine in mixtures containing t[illegible].—J. Assoc. Off. Agric. Chem. 1916, v. 2, p. 73–74.

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Means, J. H., et al.: Data relative to the effect of caffeine on heat production are presented.—Arch. Intern. Med. 1917, v. 19, p. 832–839.

Mendel, L. B., and Wardell, E. L.: A study of the effect of ingestion of coffee, tea, and caffeine on the excretion of uric acid in man.—J. Am. M. Assoc. 1917, v. 68, p. 1805–1807.

Hyde, I. H.: A study of the effects of caffeine on work in an athlete and a nonathlete. Small doses increased the power to do work in both subjects. A dose of 3.58 grains depressed the muscular power for work.—Am. J. Physiol. 1917, v. 43, p. 391–394.

Schultz, Hugo: An investigation of the influence of alcohol and caffeine-containing foods upon the red and green color sense.—Arch. ges. Physiol. 1917, v. 166, p. 217–239, through Physiol. Abstr. 1917, v. 2, p. 232.

CALCII CARBONAS PRÆCIPITATUS.

Statham, N.: British patent No. 102928. Light calcium carbonate is prepared by spraying milk of lime through an atmosphere of CO_2.—Chem. Abstr. 1917, v. 11, p. 1026.

Montgomery, E. T., and Groves, M. M.: Data relative to the disassociation of calcium carbonate by heat are presented.—Trans. Ceram. Soc. 1916, v. 18, p. 214–222, through Chem. Abstr. 1917, v. 11, p. 291.

Berthelot, A.: A discussion of the use of calcium carbonate in therapeutics. The physical properties of calcium carbonate precipitated under different conditions are discussed with reference to their therapeutic properties.—J. pharm. et chim. 1917, v. 16, p. 57–58.

Roberts, J. G.: In each of two samples of precipitated calcium carbonate examined, a slight excess of water soluble impurities was found. The samples were considered to be of normal quality, as this is usually the case.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 82.

CALCII CHLORIDUM.

Rordorf, Helene: The preparation of pure calcium chloride from calcium carbonate and hydrochloric acid is described.—Schweiz. Apoth.-Ztg. 1916, v. 54, p. 239–240.

McPherson, A. T.: Data relative to the value of granular calcium chloride as a drying agent are presented.—J. Am. Chem. Soc. 1917, v. 39, p. 1217–1219.

Bagster, Lancelot S.: A study of the composition of certain compounds of calcium chloride and acetone.—J. Chem. Soc. Lond. 1917, v. 111, p. 494–497.

CALCII GLYCEROPHOSPHAS.

Couch, James F.: An account of experiments designed to furnish knowledge of the behavior of calcium glycerophosphate in solution,

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and the effect upon the salt of those substances which are commonly associated with it in pharmaceutical mixtures.—Am. J. Pharm. 1917, v. 89, p. 243–251.

Dohme, A. R. L.: The committee on standards and deterioration of the American Drug Manufacturers' Association finds it desirable to determine whether or not citric acid should be used in calcium glycerophosphates, as about 5 per cent of this materially increases its solubility.—Proc. Am. Drug Mfg. Assoc. 1917, p. 185.

CALCII PHOSPHAS PRÆCIPITATUS, N. F.

Ramsay, A. A.: An investigation of the solubility of calcium phosphate in citric acid. The substances sold as "phosphate of lime" and "Calcii Phosphas B. P." are not pure $Ca_3(PO_4)_2$ but are mixtures of di- and tricalcic phosphates.—J. Agric. Sci. 1917, v. 8. p. 277–298.

Chirikov, F. V., and Khardin, N. V.: A study of the action of 2 per cent acetic acid on calcium phosphate.—Ann. Inst. Agron. Moscou, 1916, v. 22, p. 104–114, through Exper. Sta. Rec. 1917, v. 36, p. 712.

Patch, E. L.: One lot of precipitated calcium phosphate labeled "U. S. P." contained 1.32 per cent of calcium chloride; another lot labeled "Technical" contained but 1.1 per cent of calcium chloride.—J. Am. Pharm. Assoc. 1917, v. 6, p. 311.

CALCII SULPHIDUM CRUDUM.

Dohme, A. R. L.: The committee on standards and deterioration of the American Drug Manufacturers' Association finds it desirable to determine the rate of deterioration of calcium sulphide.—Proc. Am. Drug Mfg. Assoc. 1917, p. 185.

CALX.

Dohme, A. R. L.: It is difficult to obtain a good grade of calcium oxide due to incomplete calcination.—Proc. N. W. D. A. 1917, p. 507.

Whetzel, J. C.: A report of extensive experiments to determine the effect of exposure to atmosphere during shipment on the quality of lime.—J. Ind. Eng. Chem. 1917, v. 9, p. 287–290.

Anon.: Commercial lime may contain 50 per cent of magnesia, also iron and other impurities.—J. Am. Pharm. Assoc. 1917, v. 6, p. 411.

Busvold, N.: A description of a simple method for the determination of calcium oxide in the presence of calcium carbonate.—Tidskr. Kem. Farm. Terap. 1917, v. 14, p. 143–144.

[illegible]er, Mary V., and Marden, J. W.: A comparison of the efficiency of some common desiccants, including lime.—J. Am. Chem. [illegible]. 39, p. 1609–1614.

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CALX CHLORINATA.

Chem. Fabrik Griesheim Elek.: Swedish patent No. 41898. For the preparation of high percentage calcium hypochlorite, moist calcium hydroxide is chlorinated by introducing so much chlorine that no free oxide remains, and the solid hypochlorite removed from the mother liquor.—Chem. Abstr. 1917, v. 11, p. 1732.

Roberts, J. G.: A sample of chlorinated lime taken from a cork-stoppered bottle that had been in stock for some time contained only 0.67 per cent of available chlorine. Another sample taken from an air-tight can yielded 29.33 per cent.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 82.

Patch, E. L.: Three samples of chlorinated lime yielded 14.6, 30.07, and 35.7 per cent, respectively, of available chlorine.—J. Am. Pharm. Assoc. 1917, v. 6, p. 411.

Taylor, R. L.: A study of the effect of light on solutions of bleaching powder.—J. Soc. Dyers Colourists, 1917, v. 33, p. 246–250, through Chem. Abstr. 1918, v. 12, p. 979–980.

Dijon, Dubard: Notes on the disinfection of the hands with calcium and magnesium hypochlorites.—Rev. d'Hyg. v. 38, p. 892, through J. Pharm. chim. 1917, v. 15, p. 125.

CAMPHORA.

Asahi Camphor Refining Co.: Japanese patent No. 30606 describes a process for preparing pure powdered camphor.—Chem. Abstr. 1917, v. 11, p. 2390.

Anderson, George E.: It is estimated that the amount of gum camphor imported into the United States during the fiscal year ending June 30, 1917, will approximate 5,400,000 pounds of the crude material and 4,000,000 pounds of synthetic and refined camphor.—Com. Rep. 1917, No. 131, p. 886–887.

Anon.: An article dealing with the production of gum camphor in Florida.—Oil, Paint & Drug Rep. 1917, v. 91, No. 10, p. 18.

Hood, Samuel C.: Data on the factors causing the variation in the yield of camphor in the Florida camphor tree.—J. Ind. & Eng. Chem. 1917, v. 9, p. 552–555.

Anon.: According to figures occurring in the Board of Trade Journal, the production of camphor in Japan for the year ending March 31, 1917, is estimated at 2,148,197 pounds. The same journal estimates the production of camphor in Formosa for this period at 6,619,461 pounds.—Com. Rep. 1917, No. 86, p. 163.

Scidmore, George H.: It is stated that the Monopoly Office in Tokyo estimates the output of camphor in Formosa for 1917 at 11,616,000 pounds.—Com. Rep. 1917, No. 107, p. 500.

Anon.: Statistics showing the amount of gum camphor imported by various countries during the years 1913 to 1917 are given.—Oil, Paint & Drug Rep. 1917, v. 91, No. 25, p. 16.

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Kauffmann, Hugo: A comprehensive description of the manufacture of artificial camphor.—Chem. Abstr. 1917, v. 11, p. 1014.

Kafuku, K.: The leaves of *Alpinia nutans* Roscoe contain 0.053 per cent of a volatile oil of camphorlike odor, the essential constituents of which are camphor (more than 30 per cent) and camphane (17 per cent).—J. Chem. Ind. Tokyo, 1917, v. 20, p. 349, through Chem. Abstr. 1917, v. 11, p. 2387.

Vordier, H., and Roy, G.: A report of experiments showing the colloidal state of camphor in water in the presence of camphorated oil, and a discussion of the biologic and therapeutic consequences.—Compt. rend. Acad. sc. 1917, v. 164, p. 648–650.

Lajoux, H.: A review dealing with the liquefaction of a mixture of camphor and phenol.—J. pharm. et chim. 1917, v. 16, p. 79–81.

Anon.: Romanelli uses camphor as a preservative for aqueous solutions of substances liable to change. He drops a bit of the drug into the bottle and floats it on the surface of the liquid. Not dissolving readily, its fumes appear to fill the bottle and destroy any germs which may enter. He has thus kept white of egg unaltered for 10 years, and a 5 per cent solution of gelatin for a year or more without change.—Merck's Rep. 1917, v. 26, p. 118.

Barnard, H. E.: One sample of camphor examined was rejected because of poor quality.—Bull. Indiana Bd. Health, 1917, v. 20, p. 184.

Joachimoglu, Georg: A comparative study of the action of d-, l-, and i-camphor. I. The toxic action on cats. II. The action on the isolated frog heart. III. The antiseptic action. No difference in the physiological action of the different forms was observed.—Arch. exper. Path. u. Pharmakol. 1917, v. 80, p. 1–7, 259–281 and 282–287.

CANNABIS.

Farwell, Oliver Atkins: The U. S. P., IX, states that cannabis is derived from *Cannabis sativa* Linné or its variety *Indica* Lamarck. To quote Lamarck as the author of a botanical variety Indica is absurd; there never has been, in so far as I have been able to ascertain, a properly described botanical variety under the name of *Indica*.—Drug. Circ. 1917, v. 61, p. 174.

Fuller, H. C.: The standard for cannabis is too high and the proper labeling of specimens in order to conform to the food and drugs act will cause some hardship to the legitimate drug trade, because the buyer of drugs is disposed to deprecate any lot that the seller can not guarantee as strictly U. S. P.—J. Am. Pharm. Assoc. 1917, v. 6, p. 71.

Rippetoe, J. R.: The requirement, "yield of alcohol extractive is not l[illegible]n 8 per cent," is too low. A good quality of drug will yi[illegible]2 per cent.—Drug. Circ. 1917, v. 61, p. 501. See also J[illegible] Assoc. 1917, v. 6, p. 463.

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Snyder, J. P.: The U. S. P. assay for cannabis has been much criticized, several workers declaring that the dose is too small to produce incoordination. This should be thoroughly investigated. From our experience we are inclined to believe that a larger dose is not necessary.—J. Am. Pharm. Assoc. 1917, v. 6, p. 714.

Hamilton, Herbert C.: The U. S. P. test for cannabis is objectionable because of the following conditions: (1) The inaccurate wording in the text. (2) The smallness of the test dose. (3) The absence of a uniform standard. (4) The nonessential features which add to the complications of the method with no commensurate gain in the activity or uniformity of the product.—Am. J. Pharm. 1917, v. 89, p. 61–71.

Lyons, A. B.: A resolution anent a standard for cannabis presented by the scientific section of the American Pharmaceutical Association in 1917.—J. Am. Pharm. Assoc. 1917, v. 6, p. 877–879.

Pearson, W. A.: Notes on the proposed standard fluid extract of cannabis for use in standardizing cannabis and its preparations.—J. Am. Pharm. Assoc. 1917, v. 6, p. 876.

Pittenger, Paul S.: Notes on the U. S. P. method for the physiological standardization of cannabis.—J. Am. Pharm. Assoc. 1917, v. 6, p. 866–869.

Anon.: Experiments conducted in the H. K. Mulford laboratories to determine if there is any difference in the activity of the male and female cannabis plants showed that the female plants tested 200 per cent of normal, while the activity of the male plants was only 50 per cent of normal.—Drug. Circ. 1917, v. 61, No. 3, p. 25.

Eckler, C. R., and Miller, F. A.: A report of an investigation to determine the deterioration of crude Indian cannabis on storing. The results of the tests indicate that the loss in activity is practically 100 per cent after about 50 months.—J. Am. Pharm. Assoc. 1917, v. 6, p. 872–875.

Tobler, Walther: From an investigation it is concluded that the diuretic principle of cannabis indica is a component of cannabinol, as there is no difference between the diuretic action of cannabinol before and after distillation.—Ztschr. exper. Path. u. Pharmakol. 1916, v. 18, p. 91–92, through Zentralb. Biochem. u. Biophys. 1917, v. 19, p. 47.

Perry, E. J.: *Cannabis indica* grown in South Carolina was found to yield 11.5 per cent seeds and 15.3 per cent oleoresin. These figures correspond to those obtained on the average for a good quality of Indian hemp.—Oil, Paint & Drug Rep. 1917, v. 92, No. 15, p. 56.

Dohme, A. R. L.: Two samples of American cannabis examined contained 15 per cent to 18 per cent of seed.—Proc. N. W. D. A. 1917, p. 519.

Patch, E. L.: A sample of American-grown cannabis examined was of fine color and appearance, but gave only 5.96 per cent of ether-

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soluble constituents against an average of 11 per cent in foreign-grown.—J. Am. Pharm. Assoc. 1917, v. 6, p. 311.

CANTHARIS.

Scoville, Wilbur L.: The U. S. P. still puts faith in cantharides preparations, although most of the evidence is against their reliability. The next revision committee should have positive evidence of reliable methods of extraction and of practical solvents for this drug, on which it can base its formulas.—Am. Druggist, 1917, v. 65, No. 1, p. 26.

van Zijp, C.: Chemical notes on cantharidin and its isolation from *Epicuta Ruficeps* Ill.—Pharm. Weekblad, 1917, v. 54, p. 295–301.

Gadamer, J.: Researches on the constitution of cantharidin. VI. Isocantharidin. VII. The pyrogenic decomposition of barium cantharate.—Arch. Pharm. 1917, v. 255, p. 277–302, 315–337, through J. Chem. Soc. Lond. 1917, v. 112, part 1, p. 659 and 704–705.

Rudolph, V. W.: A study of certain reactions of cantharidin. These reactions may be explained by one or more of the three formulas for cantharidin proposed by Gadamer.—Arch. Pharm. 1916, v. 254, p. 423–456, through J. Chem. Soc. Lond. v. 112, part 1, p. 468–469.

Anon.: The United States Department of Agriculture announces that cantharides is sometimes adulterated with Chinese blister flies.—J. Am. M. Assoc. 1917, v. 69, p. 172.

Anon.: The cantharidin content of six samples of Chinese cantharides assayed was above standard.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 92.

Lipsits, Samuel T., et al: A report of a case of polycythemia as a result of cantharides poisoning.—Arch. Int. Med. 1917, v. 20, p. 913–918.

Azzi, Azzo: Histological descriptions of changes in the kidneys in poisoning by cantharides, potassium dichromate, and mercuric chloride.—Arch. sci. med. 1917, v. 40, p. 125–137.

CAPSICUM.

Dohme, A. R. L.: The committee on standards and deterioration of the American Drug Manufacturers' Association states that the oleoresin standard of 15 per cent for capsicum seems too high for an average, as in some seasons not more than 12 per cent is the average yield.—Proc. Am. Drug Mfg. Assoc. 1917, p. 185.

Congdon, Leon A.: Some notes on the different varieties of red peppers and their sources.—Simmon's Spice Mill, 1917, v. 40, p. 48–49.

Boyles, F. M.: Data showing the need for changes in the standards for capsicums and chillies.—J. Ind. Eng. Chem. 1917, v. 9, p. 301.

[illegible]: The oleoresin content of 4 samples of capsicum assayed [illegible] standard.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 92.

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Lea, E. J.: Of two samples of capsicum examined, one was re-
ected.—Rep. California Bd. Health, 1917, p. 162.

Patch, E. L.: Six samples of capsicum examined yielded from
).5 per cent to 24 per cent of alcohol extract and from 6 to 8 per
ent of ash.—J. Am. Pharm. Assoc. 1917, v. 6, p. 311.

Saure et al.: The nonvolatile ether extract of three samples of
apsicum tested was 16.24, 16.57, and 16.02 per cent, respectively
he ash varied from 6.73 to 7 per cent.—Rep. Kansas Bd. Health,
917, v. 13, p. 263.

Street, John Phillips: The examination of 17 commercial samples
f cayenne pepper gave results as follows: Total ash, 5.35 to 8.56 per
ent; crude fiber, 14.85 to 27.73 per cent; and nonvolatile ether
xtract, 3.94 to 19.21 per cent.—Rep. Connecticut Agric. Exper.
ta. 1917, p. 151.

CARAMEL, N. F.

Cunningham, Mary, and Dorée, Charles: Contributions to the
hemistry of caramel. Part I. Caramelan.—J. Chem. Soc. Lond.
917, v. 111, p. 589–608. See also Arthur Lapworth and Frederick
Wykes, p. 790–798.

Roberts, J. G.: Of three samples of caramel examined, only one
complied with the N. F., IV, requirements. One sample was low in
specific gravity, while the other yielded a precipitate when treated
with phosphoric acid.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 82.

CARBO LIGNI.

Cole, Sydney W.: A note on the scarcity of pure blood charcoal in
England.—Chem. & Drug. 1917, v. 89, p. 755.

Nikitin: Data relative to the heat of combustion of wood charcoal
are presented.—J. Russ. Phys.-Chem. Soc. 1916, v. 48, p. 54–75,
through J. Soc. Chem. Ind. 1917, v. 36, p. 282.

Joachimaglu, Georg: A method is given for estimating the ad-
sorption capacity of charcoal by means of iodine solution. A charcoal
should have such adsorptive capacity that 0.1 gram takes up at least
the iodine equivalent of 10 cubic centimeters of N/10 solutions.—
Biochem. Ztschr. 1916, v. 77, p. 1–13, through J. Chem. Soc. Lond.
1917, v. 112, part 2, p. 42. See also Pharm. Weekblad, 1917, v. 54,
p. 1173.

Gustafson, Bror: A report of experiments to determine the power
of adsorption by charcoal in alcoholic solutions.—Chem. Abstr. 1917,
v. 11, p. 554.

Richardson, Leon B.: Experimental data relative to the adsorption
of carbon dioxide and ammonia by charcoal.—J. Am. Chem. Soc.
1917, v. 39, p. 1828–1848.

Valentiner, S.: A report of a peculiar phenomenon of gas adsorp-
tion by wood charcoal.—Chem. Abstr. 1917, v. 11, p. 1359.

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Doroshevskii, A. G., and Pavlov, G. S.: A report of investigations dealing with the oxidizing effect of charcoal. In the presence of water vapor and alkali, sulphur is oxidized to sulphuric acid.—J. Russ. Phys. Chem. Soc. Proc. 1916, v. 48, p. 196, through Chem. Abstr. 1917, v. 11, p. 3171.

CARDAMOMI SEMEN.

Farwell, Oliver Atkins: The proper name for the plant from which cardamom is obtained is *Ammomum Cardamomum* Linné. If the latter generic name is to be used the correct citation would be *Elettaria Cardamomum* (Linné) Maton.—Drug. Circ. 1917, v. 61, p. 231.

Memminger, Lucien: An account of the production of cardamom seed in south India, with statistics showing the quantities exported during the years 1914 to 1916.—Com. Rep. 1917, No. 301, p. 1158.

CARUM.

Alsberg, C. L.: As a tentative standard for caraway seed, the Bureau of Chemistry requires that the material shall not contain more than 3 per cent of harmless foreign matter and shall yield not more than 8 per cent of ash.—S. R. A.-Chem. 1917, No. 19, p. 51.

Holmes, E. M.: Remarks on the cultivation of caraway and dill.—Perf. & Ess. Oil Rec. 1917, v. 8, p. 251–252.

Rusby, H. H.: A sample of caraway seed examined was contaminated with a sclerotium quite closely related to ergot.—J. Am. Pharm. Assoc. 1917, v. 6, p. 311.

CARYOPHYLLUS.

Farwell, Oliver Atkins: The proper authority for "*Eugenia aromatica* (Linné)" is "Baillon," not "O. Kuntze" as given in the Pharmacopœia. The proper name, however, under *Eugenia* is *Eugenia caryophyllata* Thunb. The synonym "*Jambosa Caryophyllus* (Sprengel) Niedenzu" should be enclosed in marks of parentheses.—Drug. Circ. 1917, v. 61, p. 174.

Starrett, Henry P.: A consular report on the clove industry of Zanzibar.—Com. Rep. 1917, No. 135, p. 956–959.

Sindall, Harry E.: In a report on spices, data relative to the determination of moisture in whole and ground cloves are presented. The method employed involves distillation with kerosene.—J. Assoc. Off. Agric. Chem. 1917, v. 2, part 2, p. 197–200.

Street, John Phillips: The examination of eight commercial samples of cloves gave results as follows: Total ash, 5.96 to 7.62 per cent; crude fiber, 8.17 to 13.86 per cent; and nonvolatile ether extract, 6.40 to 19.86 per cent.—Rep. Connecticut Agric. Exper. Sta. 1917, p. 151.

Anon.: Notice of judgment No. 4778 relates to the adulteration of cloves.—S. R. A.-Chem. 1917, p. 351.

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CASCARA SAGRADA.

Hubbard, W. S.: Methods for the identification of emodin-bearing drugs.—J. Ind. & Eng. Chem. 1917, v. 9, p. 518–521.

Beal, George D., and Okey, Ruth: Description of methods for the qualitative identification of the drugs containing emodin.—J. Am. Chem. Soc. 1917, v. 39, p. 716–725.

CASCARILLA, N. F.

Roberts, J. G.: One lot of cascarilla bark examined was of undesirable quality because it contained about 20 per cent of twigs and stems, and did not comply with the standards given by various authorities.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 82.

CAULOPHYLLUM, N. F.

Dohme, A. R. L.: One lot of blue cohosh examined contained 5 per cent of earthy material, 15 per cent of twin leaf root, and 3 per cent of unicorn.—Proc. N. W. D. A. 1917, p. 519.

CENTAURIUM, N. F.

Farwell, Oliver Atkins: The proper botanical designation for centauri is *Centaurium Centaurium* (Linné) W. F. Wight.—Drug. Circ. 1917, v. 61, p. 229.

CERA ALBA.

Anon.: An account of a visit to a plant for bleaching beeswax. The various steps in the process are described.—Chem. & Drug. 1917, v. 80, p. 477.

Dohme, A. R. L.: One sample of white wax was not of U. S. P. quality, as its acid number was only 12.8 and its ester number only 40.6, whereas the U. S. P. requires an acid number of not less than 17 nor more than 23, and an ester not less than 72 nor more than 79.—Proc. N. W. D. A. 1917, p. 515.

Ehmann, K. F.: Data showing the melting point, acid number, saponification value, and iodine value of 15 commercial samples of white wax.—J. Am. Pharm. Assoc. 1917, v. 6, p. 347.

CERA FLAVA.

Starrett, Henry P.: The total exportation of beeswax from British East Africa for the year ending March 31, 1915, is stated to amount to 1,563 hundredweight of 112 pounds. Germany took about 50 per cent of this; France, 15 per cent; United Kingdom, 14 per cent; Belgium, 11 per cent; Italy and Holland, the remainder.—Com. Rep. 1917, No. 69, p. 1111.

Anon.: A presentation of analytical data obtained in the examination of various kinds of waxes, including beeswax.—J. pharm. et chim. 1917, v. 15, p. 324–325; Répert. pharm. 1917, v. 28, part 2, p. 270–271.

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Roberts, J. G.: A sample from one lot of yellow beeswax examined showed evidence of having been adulterated, as its ester number was only 51.6 instead of the U. S. P. requirement of 72 to 77.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 83.

W. G. N. v. d. S.: A book review of a volume by Fr. Berger on the history and medicinal applications of honey and wax.—Chem. Weekblad, 1917, v. 14, p. 793.

CERATA.

Beringer, George M.: The use of petrolatum in the preparation of cerates did not yield a uniformly smooth product and was not satisfactory in other respects; hence the return in the formula of white wax and benzoinated lard was decided upon.—Am. J. Pharm. 1917, v. 89, p. 350.

Roller, Emil: Since the official cerates all contain lard, they should be classed as ointments and the name cerate be omitted from the Pharmacopœia.—D.-A. Apoth.-Ztg. 1917, v. 38, p. 31.

CERATUM CANTHARIDIS.

Asher, Philip: A method of assay for cantharides cerate should be included in the U. S. P.—Am. J. Pharm. 1917, v. 89, p. 175.

Beringer, George M.: Acetic acid has been introduced into the formula for the preparation of cantharides cerate for the purpose of liberating the cantharidin and of aiding the solution of the latter in the turpentine.—Am. J. Pharm. 1917, v. 89, p. 350.

CERATUM RESINÆ COMPOSITUM, N. F.

Anon.: Notes on the preparation and preservation of rosin cerate.—N. A. R. D. J. 1917, v. 23, p. 593.

CEREVISIÆ FERMENTUM COMPRESSUM, N. F.

Editorial: An article describing the manufacture of commercial yeast. Illustrated.—Am. Food J. 1917, v. 12, p. 143–148.

Cadwell, H. V.: A description of the tests employed in the control of yeast manufacture.—Am. Food J. 1917, v. 12, p. 151–152.

Anon.: For the preservation of compressed yeast, keeping in pure glycerin in a covered vessel in a dry place is recommended.—Pharm. Zentralh. 1916, v. 57, p. 761 through Schweiz. Apoth. Ztg. 1917, v. 55, p. 420.

Bokorny, T.: Further methods for the preparation of permanent yeast are given.—Allg. Brauer u. Hopf. Zeit. 1916, v. 56, p. 1547–1550, through J. Soc. Chem. Ind. 1917, v. 36, p. 300.

Bokorny, T.: A report of experiments showing the presence of [illegible] in and myrosin in compressed yeast.—Biochem. Ztschr. 1916, [illegible] 376, through Chem. Abstr. 1917, v. 11, p. 260.

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Anon.: An editorial discussing the therapeutic value of yeast.—J. Am. M. Assoc. 1917, v. 69, p. 826.

Hawk, Philip B., et al.: A report on the use of baker's yeast in diseases of the skin and of the gastrointestinal tract.—J. Am. M. Assoc. 1917, v. 67, p. 1243–1247.

Hess, A. F.: From experiments it is concluded that yeast has no antiscorbutic value.—Chem. Abstr. 1917, v. 11, p. 1461.

CETACEUM.

Lundin: The hydrostatic methods for the determination of the specific gravity of spermaceti are preferable to Hager's flotation method. The limits of the Ph. Germ. V for specific gravity, 0.940–0.945, are too narrow.—Schweiz. Apoth.-Ztg. 1917, v. 55, p. 221.

CHIRATA, N. F.

Farwell, Oliver Atkins: The proper botanical designation for chirata is *Swertia Chirayita* (Roxb.) Farwell.—Drug. Circ. 1917, v. 61, p. 229–230.

CHLORALUM HYDRATUM.

François, Maurice: Descriptions of methods for the identification and determination of the purity of chloral hydrate, and the quantitative estimation of chloral hydrate *per se* and in standard solutions and syrups.—Ann. Falsif. 1917, v. 10, p. 575–581; J. pharm. et chim. 1917, v. 16, p. 289–299.

Sayre, et al.: Three samples of chloral hydrate examined were of U. S. P. quality.—Rep. Kansas Bd. Health, 1917, v. 13, p. 169.

CHLOROFORMUM.

Michaelis, G.: U. S. patent No. 1,203,032. A procedure for the purification of chloroform which consists principally of shaking with sulphuric acid.—Chem. Abstr. 1917, v. 11, p. 85.

Utz: To 10 cubic centimeters of chloroform add as much benzidine as will lie on the point of a knife and shake gently when a clear solution will be formed. If the chloroform is pure the solution will keep unchanged in the dark for 24 hours. If 0.01 per cent of phosgene is present, the solution becomes cloudy almost at once. If chlorine is present the solution acquires a pale rose and then a blue color. If hydrochloric acid is present, the solution becomes cloudy at once.—Pharm. Zentralh. 1917, v. 58, p. 1–5, through Ztschr. angew. Chem. 1917, v. 30, part 1, p. 121.

Fujiwara, K.: A description of a new reaction for the detection of chloroform. The test is based on the color reaction produced by a reagent consisting of a solution of sodium hydroxide and pyridine.—Chem. Abstr. 1917, v. 11, p. 3201.

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Graham, Evarts A.: A discussion of biochemical changes produced by chloroform and other anesthetics.—J. Nat. Dental Assoc. 1917, v. 4, p. 733–739; J. Am. M. Assoc. 1917, v. 69, p. 1666–1669.

Fiessinger, N., and Montaz, R.: A report of a case of liver injury due to the administration of chloroform to produce anesthesia.—Rev. de Chirurgie, 1916, v. 35, p. 424, through J. Am. M. Assoc. 1917, v. 68, p. 1878.

CHONDRUS.

Piorkowski: A discussion of the use of mucilage of Irish and Iceland moss as substitutes for salve bases, cold creams, glycerol, soap, and fat; also in the preparation of emulsions for the reduction of the bitter taste in certain drugs, especially laxatives, and finally as culture media for bacteria.—Chem. Zentralbl. 1916, v. 2, p. 158, through Chem. Abstr. 1917, v. 11, p. 1879.

CHRYSAROBINUM.

Hess, O.: A reexamination of the constituents of commercial chrysarobin undertaken in consequence of Tutin and Clewer's description of the constituents of commercial chrysarobin. Purified chrysarobin consists of the anthranols, chrysophanol ($C_{15}H_{12}O_3$), and emodinol ($C_{15}H_2O_4$), and their methyl ethers. Chrysophanol methyl ether is not present in the chrysarobin of commerce which contains about 33 per cent of chrysophanol. The therapeutic action of the drug is due to the anthranols only.—Ann. Chem. 1917, v. 413, p. 350–378, through J. Chem. Soc. 1917, v. 112, No. 1, p. 276.

Eder, R.: A report of investigations dealing with the identification of the constituents of commercial chrysarobin.—Arch. Pharm. 1916, v. 254, p. 1, through Chem. Abstr. 1917, v. 11, p. 1252.

Unna, P. G.: Cignolin (1, 8-dihydroxyanthranol) is stated to have a much more energetic action on the skin than chrysarobin, which is the 3-methyl derivative.—Dermatol. Wchnschr. 1916, v. 62, No. 6–8, through J. Soc. Chem. Ind. 1917, v. 36, p. 565.

CIMICIFUGA.

Rusby, H. H.: The extract and fluid extract of cimicifuga are in the U. S. P. and the tincture is in the N. F. It is rather an unimportant drug, and it is not understood why more than one preparation is retained.—Pract. Drug. 1917, v. 35. No. 3, p. 27; Proc. Am. Drug Mfg. Assoc. 1917, p. 11.

CINCHONA.

Puente y Sánchez, Carlos: A discussion of the evaluation of the [illegible]na barks by the use of picrolonic acid. Experimental data are [illegible]arm. Españ. 1917, v. 49, p. 689–691, 705–706, 721–725.

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Hebeisen, F.: A description of a method for the evaluation of inchona bark.—Pharm. Weekblad, 1917, v. 54, p. 1173; Apoth. tg. 1917, p. 95.

van Itallie, L., and Lemkes, H. J.: A chemical examination of *Cinchona robusta*, a hybrid of *C. officinalis* and *C. calisaya*, showed that t is unsuitable as a possible source of quinine.—Pharm. Weekblad, 917, v. 54, p. 1225–1234.

Rabe, Paul, and Böttcher, Bruno: A report of researches dealing ith the constitution of the cinchona alkaloids.—Ber. deutsch. chem. esellsch. 1916, v. 49, p. 2753–2756 through J. Chem. Soc. Lond. 917, v. 112, part 1, p. 216-217 and Ber. deutsch. chem. Gesellsch. 917, v. 50, p. 127–133, through J. Chem. Soc. Lond. 1917, v. 112, art 1, p. 281.

Léger, E.: A report of researches dealing with the action of hydro- romic acid on cinchonine and its isomers, cinchoniline, cinchonigine, nd apocinchonine, and the chemistry of other derivatives.—Bull. oc. chim. France, 1917, v. 23, p. 133–142, 142–146, 240–249, 328–335.

Kaufmann, Adolf, et al.: A report of researches dealing with the legradation of the cinchona alkaloids.—Ber. deutsch. chem. Ge- ellsch. 1916, v. 49, p. 2299–2310, through J. Chem. Soc. Lond. 1917, . 112, part 1, p. 50.

Biddle, H. C., and Watson, Thomas: An investigation of the in- luence of varying concentration of hydrogen-ion on the optical rota- tion of isomeric alkaloids, cinchonine, cinchonidine, and cincho- toxine.—J. Am. Chem. Soc. 1917, v. 39, p. 968–974.

Glücksmann, C.: A report on the isolation of a new constituent rom cinchona bark. The substance isolated is a green coloring matter called "tschirchin" by the author.—Schweiz, Apoth-Ztg. 1917, v. 55, p. 29–30; Chem. Abstr. 1917, v. 11, p. 1724.

Anon.: Of 15 samples of yellow cinchona assayed, the total alka- loidal content of 14 was above standard and 1 below.—Proc. Pennsyl- vania Pharm. Assoc. 1917, p. 92.

Dohme, A. R. L.: The quality of all 15 shipments of cinchona bark examined was good and assayed from 6.5 per cent to 12 per cent total alkaloids.—Proc. N. W. D. A. 1917, p. 507.

Englehardt, H.: Of 19 samples of cinchona assayed, 3 were found to be below the U. S. P. standard of 4 per cent of ether-soluble alka- loids.—J. Am. Pharm. Assoc. 1917, v. 6, p. 408.

Dohme, A. R. L.: Nine samples of cinchona examined tested 5.7 per cent and up to 10.2 per cent of alkaloids. Three of the nine were above 9.5 per cent.—Proc. N. W. D. A. 1917, p. 509.

Scoville, W. L.: Of 15 samples of cinchona examined, 2 contained 0.5 of ether-soluble alkaloids or less, 1 contained 0.84 per cent; 6 contained between 1 per cent and 2 per cent; 2 contained between 2 per cent and 3 per cent; 4 contained above 5 per cent, the highest containing 6.4 per cent.—J. Am. Pharm. Assoc. 1917, v. 6, p. 408.

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CINCHONA RUBRA.

Demilly, Jean: Note on the alkaloidal content of *Cinchona succiruba* grown in a greenhouse.—Bull. Sc. pharmacol. 1917, v. 24, p. 32–33.

Anon.: Of seven samples of red cinchona assayed, the total alkaloidal content of 6 was above standard and 1 below.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 92.

CINCHONINÆ SULPHAS.

Biddle, H. C., and Watson, Thomas: A study of the influence of varying concentration of hydrogen-ion on the optical rotation of the isomeric alkaloids, cinchonine, cinchonidine, and cinchotoxine.—J. Am. Chem. Soc. 1917, v. 39, p. 968–974.

CINNAMOMUM SAIGONICUM.

von Fellenberg: A colorimetric method for the evaluation of cinnamon, cassia, and vanilla.—Am. Perf. 1917, v. 11, p. 324.

Dohme, A. R. L.: One sample of cinnamon (Saigon) examined had been adulterated with cassia cinnamon.—Proc. N. W. D. A. 1917, p. 519.

Drummond, W. B.: A favorable report on the use of powdered cinnamon as a prophylactic in measles.—Brit. M. J. 1917, v. 1, p. 705.

CINNAMOMUM ZEYLANICUM.

Farwell, Oliver Atkins: The proper binomial for this product is *Cinnamomum Cinnamomum* (Linné) Karsten.—Drug. Circ. 1917, v. 61, p. 174.

COCA (NONOFFICIAL).

Higgins, S. B.: A short historical account of the manner in which coca came to be used as a medicinal agent.—Pract. Drug. 1917, v. 35, No. 5, p. 26–27.

Roberts, J. G.: The only lot of cocoa leaves examined yielded 0.86 per cent of ether-soluble alkaloids.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 83.

COCAINA.

Denigès, G.: A rapid micro-chemical method for the identification of solutions of cocaine and stovaine.—Bull. Soc. pharm. Bordeaux, 1917, v. 55, p. 323–326.

Hankin, E. H.: Descriptions of tests for a number of narcotic and anesthetic drugs, including heroin, cocaine, cocaine substitutes, and some of the so-called hypnotics.—Indian J. M. Res. 1916, v. 4, p. [illegible] through Analyst, 1917, v. 42, p. 174.

[illegible]m, O.: The numbing of the tongue when cocaine is tasted [illegible] be a reliable, practical test for distinguishing between [illegible] atropine.—Apoth. Ztg. 1917, v. 32, p. 38.

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Baumeister, Th.: Notes on the sterilization of solutions of cocaine hydrochloride. It is stated that solutions can be sterilized in a current of steam for one hour without decomposition, provided the operation is carried out in alkali-free glass containers.—Pharm. Weekblad, 1917, v. 54, p. 647.

Ebert: The methods of Tyndall and Baumeister for the sterilization of cocaine solutions are criticized. The author recommends that the solution be prepared with sterile water, and the container be subjected to the action of steam for three-quarters to one hour. The use of a container made of alkali-free glass is recommended.—Pharm. Ztg. 1917, v. 62, p. 53, through Ztschr. angew. Chem. 1917, v. 30, part 1, p. 175.

Barger, G. et al.: A report on the chemical and physiological properties of "collosol" cocaine.—Lancet, 1917, v. 193, p. 825.

Ducceschi, V.: The addition of cocaine (1.5 to 2.5 per cent) to the blood of the frog, fowl, and dog prevents or retards coagulation by arresting changes in the elements which normally agglutinate.—Arch. ital. biol. v. 64, p. 341–353 through Physiol. Abstr. 1917, v. 2, p. 114.

Towns, Charles B.: The horrible spread and use of cocaine grew out of so-called catarrh cures which contained from 3 to 5 per cent of the drug. This quantity was supposed to be harmless, but every druggist knows how the sale of one of these "catarrh cures" grew enormously merely on the strength of its cocaine content.—Pharm. Era, 1917, v. 50, p. 14.

COCCUS.

Stiles, George K.: The crop of Canary Island cochineal for the year 1916 is estimated to amount to approximately 727,500 pounds. There are three grades of cochineal from this source—namely, "cochinilla plateada, fina superior;" "cochinilla madres, negras superior;" and "cochinilla inferior." The third grade constitutes the crop of young or badly developed (sometimes diseased) specimens of the cochineal insect.—Com. Rep. 1917, No. 33, p. 519.

Muttelet, C. F.: Descriptions of some analytical characteristics of ammoniacal cochineal are given. A number of color reactions are described.—Anal. falsif. 1917, v. 10, p. 228–230.

CODEINA.

Tunmann, O.: A description of a microchemical method for the differentiation of morphine and codeine. The method is based on the fact that morphine and codeine yield crystalline salts with hydriodic acid which are different in form, and therefore permit of the differentiation of the two bases.—Apoth.-Ztg. 1916, v. 31, p. 148–150 through Analyst, 1917, v. 42, p. 48.

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CODEINÆ SULPHAS.

Emery, W. O.: A method for the estimation of caffeine, acetanilid, and codeine sulphate in mixtures containing the three substances is described.—J. Assoc. Off. Agric. Chem. 1916, v. 2, p. 72–73.

Roberts, J. G.: A sample of codeine sulphate examined was rejected on account of having a decided yellowish color and yielding 0.63 per cent. of ash.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 83.

COFFEA TOSTA, N. F.

Issoglio, G.: An investigation of the forms of adulteration of roasted whole coffee.—Giorn. farm. chim. 1915, v. 64, p. 337–347.

Eden, F. R.: U. S. patent No. 1,216,674 describes a method for extracting caffeine from coffee by means of hot water. The beans are roasted while still moist.—Chem. Abstr. 1917, v. 11, p. 1220.

Brauer, K.: A discussion of the useful and injurious constituents of coffee, with special reference to the Thum method of cleaning.—Pharm. Zentralh. 1916, v. 57, p. 580–581.

Gomes, Theodore: A discussion of the physiological effects of coffee with special reference to the digestive tract.—J. Am. Inst. Homeop. 1917, v. 9, p. 791–795.

COLCHICI CORMUS.

Rippetoe, J. R.: In the assay of colchicum corm, the incomplete removal of starch results in the formation of obstinate emulsions when extracting with chloroform. If 10 instead of 15 grams of the drug are used, and 150 mils of the filtrate representing 5 grams of the drug be taken, very good results are obtained.—Drug. Circ. 1917, v. 61, p. 501. See also J. Am. Pharm. Assoc. 1917, v. 6, p. 463.

Patch, E. L.: The colchicine content of four samples of colchicum root examined was 0.24, 0.26, 0.35, and 0.36 per cent, respectively. The ash ranged from 2.2 to 2.8 per cent.—J. Am. Pharm. Assoc. 1917, v. 6, p. 408.

Roberts, J. G.: One lot of colchicum root examined proved to be of very poor quality, as it contained only 0.023 per cent of colchicine and had an undesirable chalky appearance.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 83.

Anon.: The colchicine content of five samples of colchicum corm assayed was above standard.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 92.

COLCHICI SEMEN.

Engelhardt, H.: The three samples of colchicum seed examined assayed 0.605, 0.445, and 0.445 per cent of colchicine, respectively.—J. Am. Pharm. Assoc. 1917, v. 6, p. 408.

J. G.: Five lots of colchicum seed examined yielded 0.54 0.61 per cent of colchicine, therefore complying with the

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U. S. P. requirement of not less than 0.45 per cent of colchicine.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 83.

Anon.: The colchicine content of two samples of colchicum seed assayed was above standard.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 92.

COLCHICINA.

Merck, E.: A note on chemically pure colchicine. The product usually sold is colchicine containing chloroform of crystallization—14 to 16 per cent of chloroform.—Pharm. Ztg. 1916, p. 509 through Pharm. Weekblad, 1917, v. 54, p. 281.

White, E. C.: One lot of colchicine examined showed a loss of 26.8 per cent (chiefly chloroform) at 100° C.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 83.

COLLODIUM CANTHARIDATUM.

Beringer, George M.: The extraction of the cantharides with a mixture of acetone and acetic acid, instead of chloroform, as directed in the U. S. P., VIII, yields a preparation which does not gelatinize or precipitate in a short time.—Am. J. Pharm. 1917, v. 89, p. 350–351.

COLLODIUM FLEXILE.

Beringer, George M.: In flexible collodion U. S. P., IX, by the use of camphor and castor oil in appropriate proportions, a closely adhering, stronger, and more flexible film is produced than that yielded by the old formula, which contained Canada turpentine and castor oil.—Am. J. Pharm. 1917, v. 89, p. 351.

Dohme, A. R. L.: There appears to be no valid reason for replacing the Canada turpentine in flexible collodion with camphor.—Proc. N. W. D. A. 1917, p. 504.

Masland, W. E.: U. S. patent No. 1234921 describes the preparation of a solution containing 40 to 75 per cent of a mixture of aldol and castor oil with pyroxylin.—Chem. Abstr. 1917, v. 11, p. 2604.

Lindsay, W. G.: U. S. patent No. 1233374. Wet pyroxylin is mixed with tricresyl phosphate, benzyl benzoate, or other liquid solvent and the water expressed. Camphor, castor oil, or other modifying agent may be added.—Chem. Abstr. 1917, v. 11, p. 2612.

COLOCYNTHIS.

Rippetoe, J. R.: The requirement for the yield of ash in the case of colocynth should be not less than 8 nor more than 15 per cent. The pulp is always found to contain more than 8 per cent of ash.—Drug. Circ. 1917, v. 61, p. 501 See also J. Am. Pharm. Assoc. 1917, v. 6, p. 463.

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CONFECTIO SENNÆ, N. F.

Editorial: Owing to the shortage of sugar in England it is suggested that honey or glucose be used in the manufacture of confection of senna.—Chem. & Drug. 1917, v. 89, No. 1961, p. 43.

CONIUM, N. F.

Roberts, J. G.: Two lots of conium seed examined yielded 0.63 and 0.89 per cent, respectively, of coniine.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 83.

CONVALLIARIÆ RADIX, N. F.

Dohme, A. R. L.: One sample of convallaria root examined contained 25 per cent of plant leaf.—Proc. N. W. D. A. 1917, p. 519.

COPAIBA.

Dohme, A. R. L.: One lot of copaiba (Para) was soluble in 0.4 part and less of absolute alcohol. The addition of more than this amount showed a decrease in solubility.—Proc. N. W. D. A. 1917, p. 514.

Roberts, J. G.: A sample of balsam of copaiba (Para) was found to be soluble in 1.3 parts and less of absolute alcohol.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 81.

Anon.: Notice of judgment No. 4661 relates to the adulteration of balsam of copaiba.—S. R. A.-Chem. 1917, p. 214.

CORIANDRUM.

Rusby, H. H.: Great difficulties have been experienced during the year in obtaining coriander sufficiently clean. There is a remarkable tendency for this drug to contain not only various weed seeds in considerable amount but many little, hard, stonelike pellets of dirt, adding greatly to the ash content.—J. Am. Pharm. Assoc. 1917, v. 6, p. 409.

CORNUS, N. F.

Farwell, Oliver Atkins: Those species of *Cornus* in which the inflorescences are surrounded by a corollalike involucre are better considered as constituting a distinct species. The proper name for the plant under this view is *Cynoxylon floridum* (Linné) Raf.—Drug. Circ. 1917, v. 61, p. 230.

CORYDALIS, N. F.

Farwell, Oliver Atkins: The proper spelling of the generic name for corydalis is *Bikukulla*, not *Bicuculla*.—Drug. Circ. 1917, v. 61, p. [illegible].

[illegible]er, S., and Klee, W.: Researches on racemic corydaline.—[illegible]m. 1916, v. 254, p. 295, through Chem. Abstr. 1917, v. [illegible].

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COUMARINUM, N. F.

Anon.: A description of a method for the synthesis of salicylic aldehyde and the preparation of coumarin therefrom.—Perf. & Ess. Oil Rec. 1917, v. 8, p. 153.

Dox, Arthur W., and Gaessler, W. G.: An analysis of the iodine addition product of coumarin obtained in the Leach test for coumarin indicates that the compound probably has the empirical formula $(C_9H_6O_2)_2I$.—J. Am. Chem. Soc. 1917, v. 39, p. 114–117.

CREOSOTUM.

Smith, H. K., and Acree, S. F.: A report of an examination of a commercial sample of beech-wood creosote prepared by an American manufacturer.—J. Ind. & Eng. Chem. 1917, v. 9, p. 275–276.

Judd, R. C., and Acree, S. F.: A method of producing crude-wood creosote from hardwood tar.—J. Ind. & Eng. Chem. 1917, v. 9, p. 276–277.

Pieper, Ernest J., et al.: A study of the composition of the higher fractions of maple-wood creosote.—J. Ind. & Eng. Chem. 1917, v. 9, p. 462–465.

Roberts, J. G.: One lot of creosote (beech-wood) was rejected because it had a low specific gravity and contained coerulignol and other high-boiling constituents of wood tar. Another lot having a specific gravity slightly lower than the standard was considered unobjectionable.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 84.

White, E. C.: Two lots of creosote (beech-wood) examined were not completely miscible with glycerin. One lot distilled mostly above 222° C. and contained wood-tar constituents.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 84.

CRESOL.

Dohme, A. R. L.: The committee on standards and deterioration of the American Drug Manufacturers' Association finds it desirable to determine whether or not the U. S. P requirement for water solubility of cresol is too strict.—Proc. Am. Drug Mfg. Assoc. 1917, p. 195.

Fox, J. J., and Barker, M. F.: A method for the determination of phenol in commercial cresylic acid. After the addition of a certain amount of o-cresol the whole amount of phenol will appear in the first fractions of the distillate.—J. Soc. Chem. Ind. 1917, v. 36, p. 842–845.

Patch, E. L.: The specific gravity of five samples of cresol examined ranged from 1.028 to 1.038. One sample was not completely soluble in 120 parts of water.—J. Am. Pharm. Assoc. 1917, v. 6, p. 409.

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Vanderkleed, Charles E., and E'we, George E.: In solutions of alkaloids, cresol, in the proportion of 0.3 per cent, acts like an alkali, and liberates alkaloids.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 233–234.

CROCUS, N. F.

Pearson: General comments on saffron, including methods of cultivating the plant and collecting and preparing the flowers for market.—Simmon's Spice Mill, 1917, v. 40, p. 402–403.

CUBEBA.

Rusby, H. Y.: The oleoresin of cubeb is official in the U. S. P. and the fluid extract and tincture in the N. F. There is no relationship between the activity of the doses given in the two books.—Proc. Am. Drug Mfg. Assoc. 1917, p. 11; Pract. Drug. 1917, v. 35, No. 3, p. 27.

Dohme, A. R. L.: A number of samples of cubebs examined contained from 10 per cent to 18 per cent of stems.—Proc. N. W. D. A. 1917, p. 520.

Anon.: The oleoresin content of two samples of cubeb assayed was above standard.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 92.

Dohme, A. R. L.: In the seven samples of cubeb examined the percentage of oleoresin varied from 17 to 20 per cent.—Proc. N. W. D. A. 1917, p. 507.

Engelhardt, H.: The oleoresin content of six samples of cubeb examined varied from 14 to 20.52 per cent.—J. Am. Pharm. Assoc. 1917, v. 6, p. 409.

CUPRI SULPHAS.

Guareschi, Icilio: An investigation of the loss of water of hydration by $CuSO_4.5H_2O$ under different conditions of humidity and temperature.—Atti accad. sci., Torino, 1915, v. 50, p. 1125–1145, through J. Chem. Soc. Lond. 1915, v. 108, part 2, p. 774–775.

Dover, Mary V., and Marden, J. W.: A comparison of the efficiency of some common desiccants, including anhydrous copper sulphate.—J. Am. Chem. Soc. 1917, v. 39, p. 1609–1614.

Embrey, G.: An account of some experiences in the use of copper sulphate for the destruction of algæ.—Analyst, 1917, v. 42, p. 264–271.

CYPRIPEDIUM, N. F.

Farwell, Oliver Atkins: The proper botanical designation for lady slipper is *Fissipes hirsuta* (Miller) Farwe.—Drug. Circ. 1917, v. 61, p. 230.

DAMIANA, N. F.

Dohme, A. R. L.: Damiana has in late years been very largely and excessively admixed with stems and branches of the plant, which, of course, are inert and worthless.—Proc. N. W. D. A. 1917, p. 513.

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DIACETYLMORPHINA.

Schaefer, Hugo H.: From the examination of commercial specimens of diacetylmorphina and its hydrochloride, it is concluded that the U. S. P. requirements concerning the purity of this article are by no means too severe and will be easily met by the manufacturer. All of the samples commonly found on the market to-day, while showing some variations, are of sufficient purity to pass the official tests.—J. Am. Pharm. Assoc. 1917, v. 6, p. 140–142.

Müller, R.: A rapid method for determining small amounts of heroin consists in observing the color when 1 to 3 milligrams are added to a mixture consisting of 1 gram of 1 per cent sulphuric acid and 1.5 grams of a solution composed of 600 parts of sulphuric acid, 300 parts of water, and 25 parts of formaldehyde. A pale yellow to cherry-red color will develop, depending upon the amount of heroin present.—Rev. farm. 1916, v. 5, through Giorn. farm. chim. 1917, v. 66, p. 227.

Hankin, E. H.: Descriptions of tests for a number of narcotic and anesthetic drugs, including heroin, cocaine, cocaine substitutes, and some of the so-called hypnotics.—Indian J. M. Res. 1916, v. 4, p. 237, through Analyst, 1917, v. 42, p. 174.

McNally, W. D.: A description of a method for the quantitative separation of heroin from organs and body tissues. The heroin is extracted at a low temperature with dilute acid, and the alkaloid is precipitated from the acid solution by means of aluminum silicate.—J. Lab. & Clin. Med. 1917, v. 2, p. 649–654.

McNally, William D.: A report of two cases of fatal heroin poisoning.—J. Lab. & Clin. Med. 1916–1917, v. 2, p. 570–572.

Towns, Charles B.: Heroin is to-day doing more harm than any other opiate, although it is a comparatively recent morphine product, and was first used in preparations classed as cough mixtures. But any preparation containing heroin is absolutely sure to establish a tolerence if taken regularly.—Pharm. Era, 1917, v. 50, p. 14.

DIASTASUM.

Anon.: Netherlands patent No. 1878. Extraction and concentration of diastase are effected in the presence of reducing agents by adding small quantities of the latter at about 40° C.—Chem. Abstr. 1917, v. 11, p. 2026.

Boidin, A., and Effront, J.: U. S. patent No. 1227525. Diastases and toxins are prepared by the action of oxidizing enzymes upon a wort containing at least 1 part of assimilable nitrogenous material to 15 parts of carbohydrates.—Chem. Abstr. 1917, v. 11, p. 2263.

Rakuzin, M. A., and Flier, G. D.: A report of researches dealing with the optical properties of diastase and its adsorption by kaolin and by aluminum hydroxide.—J. Russ. Phys. Chem. Soc. 1916.

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48, p. 321–324, through J. Chem. Soc. Lond. 1917, v. 112, part 1, p. 181.

White, E. C.: All the diastase examined tested 1:100 instead of 1:50, as required by the U. S. P.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 84.

DIGITALIS.

Dohme, A. R. L.: The committee on standards and deterioration of the American Drug Manufacturers' Association finds it desirable to determine whether or not digitalis and its products deteriorate, and which are the most desirable.—Proc. Am. Drug Mfg. Assoc. 1917, p. 185.

Alsberg, C. L.: Examination of certain samples of importations of "digitalis" leaves by the Bureau of Chemistry has shown that the article consisted of *Digitalis thaspi* and not *Digitalis purpurea.*—S. R. A.-Chem. 1917, No. 19, p. 51.

Hoyer, Otto: A sample of digitalis powder was found to be a mixture of powdered verbascum and inula conyza leaves. Another sample examined was found to be adulterated with powdered tilia flowers.—Ztschr. allgem. österr. Apoth.-Ver. 1917, v. 11; Apoth. Ztg. 1917, v. 32, p. 69, through Ztschr. angew. Chem. 1917, v. 30, part 1, p. 175.

Nelsson, Axel: A note on exceptionally active leaves found in a lot of digitalis imported from France. A detailed histological description of these leaves is given.—Svensk farm. Tidskr. 1917, v. 21, p. 221–224.

Homes, E. M.: Attention is called to the fact that Spanish digitalis has appeared on the market. As two wild species of digitalis (*Digitalis thapsi*, Linn. and *Digitalis mariana*) grow in Spain, the author advises that the relative activity of these different species be determined before the Spanish article is accepted as a substitute for the official species.—Pharm. J. 1917, v. 98, p. 351.

Anon.: According to Wasicky the leaves of *Digitalis ambigua*, which is abundant in Austria, are as active as the leaves of *D. purpurea*, and can, therefore, take the place of the latter.—Chem. Ztg. v. 41, p. 99, through Pharm. J. 1917, v. 98, p. 375.

Farwell, O. A., and Hamilton, H. C.: On the histology and pharmacology of *Digatilis Thapsi* Lin. The observed toxicity of the drug was three times that of the average official variety.—Am. J. Pharm. 1917, v. 89, p. 147–154.

Wasicky, R.: Biological tests with *Digitalis ambigua* Murr, by the one-hour method of Hale showed it to be as valuable as the official *Digitalis purpurea* L.—Pharm. Post, 1916, v. 49, p. 297–298, through Chem. Abstr. 1917, v. 11, p. 2017.

Roth, G. B.: From experiments, it is concluded that wild Ameri- [illegible] is obtained from the West is physiologically active and

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may be utilized as a source of supply for making the official preparations.—Public Health Rep. 1917, v. 32, p. 377–380.

Sharp, Gordon: Notes on the physiological activity of digitalis grown in India.—Pharm. J. 1917, v. 99, p. 108.

Pratt, Joseph H., and Morrison, Hyman: Tests of the pharmacological activity of American-grown digitalis. The best American digitalis was found to be a Wisconsin leaf assaying 0.7 milligram per gram of frog.—J. Pharmacol. 1917, v. 9, p. 341–342.

Morris, R. Edwin: Notes on the standardization of digitalis, with experimental data showing the potency of Wisconsin, Minnesota, and English digitalis leaves.—Journal-Lancet, 1917, v. 37, p. 176–181.

Morris, R. E.: A report on the potency of different species of digitalis grown in the gardens of the University of Minnesota.—J. Am. M. Assoc. 1917, v. 68, p. 1065.

Hamilton, Herbert C.: The U. S. P. test for heart tonics is criticized because of the following features: (1) The inaccuracy of the method because the end point is obscured by the variable rate of absorption and shock in exposing the heart. (2) The standard because it is not obtained from the official drug and is not uniform in composition or activity.—Am. J. Pharm. 1917, v. 89, p. 61–71.

Krough, M.: A report of experiments with the isolated frog heart method for the standardization of digitalis. It is noted that the heart of the brown frog (*Rana temporanea*) behaves differently from the heart of the green frog (*Rana esculenta*). An abstract.—Ugeskrift for Laeger, Copengahen, 1917, v. 79, p. 475, through J. Am. M. Assoc. 1917, v. 68, p. 672.

Pittenger, Paul S.: A criticism of the technique recommended for injecting doses into the frog in the biological assay for drugs of the digitalis series.—J. Am. Pharm. Assoc. 1917, v. 6, p. 869–870.

van Leeuwen, W. Storm: Researches on the physiological evaluation of digitalis and strophanthus preparations.—Pharm. Weekblad, 1917, v. 54, p. 391–412.

van Leeuwen, W. Storm: A comparison of Hatcher's method with other methods for the standardization of digitalis. The author concludes that Hatcher's method is simpler and more accurate than the other methods now in use.—Pharm. Weekblad, 1917, v. 54, p. 890–892.

Dohme, A. R. L.: All shipments of digitalis examined were of good quality, and also met the U. S. P. biologic test.—Proc. N. W. D. A. 1917, p. 508.

Dohme, A. R. L.: Several samples of digitalis seed examined contained excessive amounts of sand and chaff.—Proc. N. W. D. A. 1917, p. 520.

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Roberts, J. G.: One sample of digitalis examined contained about 15 per cent of stems and about 10 per cent of capsules. Four out of 13 samples examined were spurious. One lot of genuine digitalis leaves examined was considered of subnormal quality on account of its low physiological activity, and because it contained about 23 per cent of stems.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 84.

Kiliani, H.: An account of work already published on the digitalis glucosides.—Arch. Pharm. 1916, v. 254, p. 255–295, through J. Chem. Soc. Lond. 1917, v. 112, part 1, p. 468.

Meyer, Ernst: A quantitative investigation of the active glucosides occurring in digitalis leaves from different species and in certain commercial digitalis preparations.—Arch. exper. Path. u. Pharmakol, 1917, v. 81, p. 261–288.

Straub, Walther: Analytical data relative to the quantities of active principles in digitalis leaves and seed are presented and discussed.—Arch. exper. Path. u. Pharmakol, 1917, v. 80, p. 53–71; J. Soc. Chem. Ind. 1917, v. 36, p. 734.

Straub, Walther: A study of the development of the typical glucosides of the leaf in germinating and growing digitalis plants.—Biochem. Ztschr. 1917, v. 82, p. 48–59, through J. Chem. Soc. Lond. 1917, v. 112, part 1, p. 615.

Straub, Walther: A comparison of the constituents of various digitalis preparations with those normally present in the leaves.—Münch. med. Wchnschr. 1917, v. 64, p. 513–514, through Ztschr. angew. Chem. 1917, v. 30, part 1, p. 257.

Wratschko, F.: A description of a new color reaction for the water-soluble active glucosides of digitalis leaves. The color is produced by a reagent consisting of orcinol dissolved in hydrochloric acid and ferric chloride solution.—Ztschr. allgem. Österr. Apoth.-Ver. 1916, v. 54, p. 263, through Physiol. Abstr. 1917, v. 2, p. 288.

Burmann, James: The author finds for carefully purified gitaline (ψ – digitoxin) the following values: $[\alpha] - 25.5°$ C. in chloroform and $-18.8°$ C. in alcohol; molecular weight 539 by the ebullioscopic method, chloroform being the solvent.—Bull. soc. chim. 1917, v. 21, p. 290–293.

Anon.: The H. K. Mulford Co. reports that a maximum of 12 per cent of oil has been obtained from certain samples of digitalis. A recent sample of the oil examined had a specific gravity of 0.9368 at 25° C., a saponification number of 205.8, and an iodine value of 64.5.—Drug. Circ. 1917, v. 61, No. 4, p. 25.

von Weizsacker, V. F.: Observations on the distribution of glucosides which increase heart action.—Arch. exper. Path. u. Pharmakol. 1917, v. 81, p. 247–260, through Physiol. Abstr. 1917 v. 2, p.

R.: A discussion of the physiological action of digi-
nann, Month. 1917, v. 52, p. 221–224.

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de Boer, S.: A discussion of the action of digitalis on the frog heart with 16 illustrations (charts).—Nederlandsch Tijschrift voor Geneeskunde, Amsterdam, 1917, v. 1, p. 701, through J. Am. M. Assoc. 1917, v. 68, p. 1671.

Ives, Robert F.: A discussion of the proper use of digitalis and its preparations in the practice of medicine.—New York M. J. 1917, v. 105, p. 1135–1137.

Hatcher, Robert A.: A discussion of digitalis therapy in relation to the present shortage in drugs.—J. Am. M. Assoc. 1917, v. 69, p. 1524–1525.

Cohn, Alfred E., and Jamieson, Ross A.: A study of the action of digitalis in pneumonia.—J. Exper. M. 1917, v. 25, p. 65–81.

Eggleston, Cary: Researches to determine the influence of large doses of digitalis and digitoxin on the blood pressures in man.—J. Am. M. Assoc. 1917, v. 69, p. 951–955.

DROSERA, N. F.

Farwell, Oliver Atkins: If *Drosera anglica* Huds. were adopted instead of *Drosera intermedia* Hayne, the other names remaining as given, the result would be more in accordance with the rules of priority.—Drug. Circ. 1917, v. 61, p. 230.

ECHINACEA, N. F.

Roberts, J. G.: About 25 per cent of one lot of echinacea examined was moldy.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 84.

ELIXIRIA.

Brown, L. A.: The N. F., IV, has adopted a number of elixirs as flavoring agents, or vehicles, with a smaller alcohol content, to obviate the objection to the undersirable effect of that substance. They are compound elixir of almond, compound elixir of cardamon, and elixir of vanillin.—Bull. Kentucky Agric. Exper. Sta. 1917, Feb. 15, p. 37.

Cook, E. Fullerton: As the elixirs of the N. F., III, were often too strongly alcoholic, especially those containing aromatic elixir, a number of new vehicle elixirs of low alcoholic strength have been introduced into the N. F., IV.—J. Am. Pharm. Assoc. 1917, v. 6, p. 77.

Congdon, Leon A.: The following are some of the elixirs which were most often found to be deteriorated in the drug stores of Kansas: Elixir of licorice; elixir of digitalis; elixir of iron, quinine, and strychnine phosphate; elixir of cinchona, iron, and strychnine; elixir of iron and ammonium acetate; simple elixir; and elixir of pepsin and bismuth.—Proc. Kansas Pharm. Assoc. 1917, p. 89.

Hommell, P. E.: The elixirs of ferric hypophosphite, ferric phosphate, ferric pyrophosphate, and ferric lactate should be dropped

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from the N. F., as physicians prefer a combination of vegetable tonics.—Proc. New Jersey Pharm. Assoc. 1917, v. 80.

Cook, E. Fullerton: The bromide elixirs of the N. F., IV, are open to criticism, in that the content of flavoring agent is much reduced and does not cover well the taste of the bromide.—J. Am. Pharm. Assoc. 1917, v. 6, p. 77.

ELIXIR AMMONII BROMIDI, N. F.

Hommell, P. E.: There is no therapeutic reason for the existence of the elixir of ammonium bromide. It should, therefore, be dismissed.—Proc. New Jersey Pharm. Assoc. 1917, p. 80.

ELIXIR AROMATICUM.

Cook, E. Fullerton: It is unfortunate that purified talc, which is not a satisfactory filtering medium, was not replaced by purified siliceous earth in the formula for the preparation of aromatic elixir. The latter substance greatly increases the speed of filtration and clarifies the elixir more promptly.—J. Am. Pharm. Assoc. 1917, v. 6, p. 75.

Burge, J. O.: A modification of the U. S. P. method for the preparation of aromatic elixir consists in the use of paper pulp as the filtering medium.—Pract. Drug. 1917, No. 3, p. 21.

ELIXIR BISMUTHI, N. F.

Hommell, P. E.: The elixir of bismuth is a valuable addition to the N. F. It is very palatable, a good sedative, and astringent to the mucuous linings of the alimentary tract. The bismuth exists in the elixir as oxide and is preferable to the subnitrate and subcarbonate, which have drawbacks.—Proc. New Jersey Pharm. Assoc. 1917, p. 80.

ELIXIR BUCHU, N. F.

Hommell, P. E.: The elixir of buchu should be dismissed from the N. F., as the elixir of buchu compound "fills the bill."—Proc. New Jersey Pharm. Assoc. 1917, p. 80.

ELIXIR CATHARTICUM COMPOSITUM, N. F.

Anon.: Directions for preparing compound cathartic elixir from the crude drugs, instead of the fluid extracts, are given.—N. A. R. D. J. 1917, v. 24, p. 1058–1059.

ELIXIR CINCHONÆ ALKALOIDORUM, N. F.

Cook, E. Fullerton: The title of the elixir of cinchona, N. F., III, has been changed to elixir of cinchona alkaloids in order to meet the G[illegible] criticism of misbranding. It is unfortunate that the [illegible]me title had to be adopted, for it will never be popular [illegible]ers.—J. Am. Pharm. Assoc. 1917, v. 6, p. 78.

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Hommell, P. E.: The acme of pharmaceutic and therapeutic science is exhibited in the cinchona elixirs and their combinations. The most fastidious prescribers will be pleased and the best therapeutic results obtained in their administration.—Proc. New Jersey Pharm. Assoc. 1917, p. 80.

ELIXIR CORYDALIS COMPOSITUM, N. F.

Anon.: Notes on the preparation of compound elixir of corydalis.—N. A. R. D. J. 1917, v. 24, p. 8 and 17.

ELIXIR FERRI, QUININÆ, ET STRYCHNINÆ, N. F.

Pozen, M. A.: Of 46 samples of elixir of iron, quinine, and strychnine examined, 43 were rejected for being below standard.—Rep. District of Columbia Health Off. 1917, p. 50–51.

Tice, William G.: One sample of elixir of iron, quinine, and strychnine examined was below standard.—Rep. New Jersey Dept. Health, 1917, p. 62.

ELIXIR FERRI, QUININÆ, ET STRYCHNINÆ PHOSPHATUM.

Brown, L. A.: The elixir of iron, quinine, and strychnine phosphates has been dropped from the U. S. P. and refused admission to the N. F. "because of difficulties or imperfections which render it pharmaceutically unsatisfactory." It would seem that the revision committee of either the U. S. P. or N. F. could have eliminated these "difficulties or imperfections" and retained this very popular and widely used preparation.—Bull. Kentucky Agric. Exper. Sta. 1917, Feb. 15, p. 38.

Glover, W. H.: It is regretted that the elixir of the phosphates, of iron, quinine, and strychnine has been dropped from the U. S. P. A satisfactory preparation can be made by following the modified method suggested by Charles Caspari, jr.—J. Am. Pharm. Assoc. 1917, v. 6, p. 1062.

Scoville, Wilbur L.: The elixir of the phosphates of iron, quinine, and strychnine has been dropped from the U. S. P. and N. F. because the research which is needed to produce a satisfactory formula has not been done.—Am. Druggist, 1917, v. 65, No. 1, p. 25.

Frary, Guy G.: Three of 20 samples of elixir of iron, quinine, and strychnine phosphates examined were not of U. S. P. quality.—Rep. South Dakota F. & D. Com. 1917, p. 103.

ELIXIR GENTIANÆ, N. F.

Cook, E. Fullerton: The N. F., IV, formula for the preparation of elixir of gentian contains sodium citrate. This is an improvement over the old process, as the bitterness of the gentian, which was impaired through the treatment with ferric hydroxide, is now retained.—J. Am. Pharm. Assoc. 1917, v. 6, p. 78.

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ELIXIR GLYCEROPHOSPHATUM, N. F.

Utech, P. Henry: A precipitate frequently forms in the elixir of glycerophosphates after a few weeks' standing, due to the separation of a portion of the calcium salt. By increasing the quantity of phosphoric acid in the formula from 8 cubic centimeters to 10 cubic centimeters the preparation will keep indefinitely.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 139.

ELIXIR GLYCYRRHIZÆ AQUOSUM, N. F.

Hommell, P. E.: There can be no need for the aqueous elixir of licorice while the aromatic elixir of licorice is official. It should therefore be dismissed—Proc. New Jersey Pharm. Assoc. 1917, p. 80.

ELIXIR GUARANÆ, N. F.

Hommell, P. E.: There is absolutely no need for the elixir of guarana in the N. F. Guarana is a nervine formerly employed for sick headache, especially those big heads following an alcoholic debauch. In these days its action is not rapid enough and coal-tar derivatives are used instead.—Proc. New Jersey Pharm. Assoc. 1917, p. 80.

ELIXIR PEPSINI ET RENNINI COMPOSITUM, N. F.

Anon.: The H. K. Mulford Co. report that kieselguhr is a very satisfactory agent for clarifying the essence of pepsin, and that it does not affect in the least the activity of the ferments in the preparation.—Drug. Circ. 1917, v. 61, No. 11, p. 25.

Casey, F. W.: One sample of essence of pepsin examined was rejected.—Bull. Michigan D. & F. Dept. 1917, No. 258–259, p. 18.

ELIXIR POTASSII ACETATIS, N. F.

Hommell, P. E.: There is no need for an elixir of potassium acetate while the one containing juniper exists. The latter is the best for use in dropsies of renal or cardiac origin.—Proc. New Jersey Pharm. Assoc. 1917, p. 80.

ELIXIR POTASSII BROMIDI, N. F.

Casey, F. W.: Of seven samples of elixir of potassium bromide examined, five were rejected because they did not meet the N. F. requirements.—Bull. Michigan D. & F. Dept. 1917, No. 256–257, p. 16; No. 258–259, p. 18; No. 260–261, p. 33; No. 264–267, p. 24.

ELIXIR RUBI COMPOSITUM, N. F.

Anon. Notes on the preparation and preservation of compound elixir of raspberry.—N. A. R. D. J. 1917, v. 24, p. 1059.

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ELIXIR SODII SALICYLATIS, N. F.

Hommell, P. E.: The syrup in the elixir of sodium salicylate should be removed and a proper proportion of glycerin should be added.—Proc. New Jersey Pharm. Assoc. 1917, p. 80

ELIXIR SODII SALICYLATIS COMPOSITUM, N. F.

Anon.: In comments on the preparation of compound elixir of sodium salicylate, it is stated that the pharmacist should give careful attention to the quality of sodium salicylate, as much of the salt appearing on the market is unfit for use in medicine.—N. A. R. D. J. 1917, v. 23, p. 942.

ELIXIR TERPINI HYDRATIS, N. F.

Hommell, P. E.: There is no need for the syrup in the elixir of terpin hydrate, as the glycerin will suffice for the sake of palatability and demulcency.—Proc. New Jersey Pharm. Assoc. 1917, p. 81.

ELIXIR TRIUM BROMIDORUM, N. F.

Anon.: In commenting on the N. F. formula for the preparation of the elixir of three bromides, the necessity of using portions of the same sample of cudbear in preparing different batches of elixir, in order that uniformity in the color of the preparation may be maintained, is pointed out.—N. A. R. D. J. 1917, v. 25, p. 185.

ELIXIR VANILLINI COMPOSITUM, N. F.

Hommell, P. E.: The elixir of vanillin compound should not have been placed in the N. F., as it is a most miserable flavoring agent, very sickening. For flavoring purposes a good tincture of vanilla bean is to be preferred.—Proc. New Jersey Pharm. Assoc. 1917, p. 80.

ELIXIR VIBURNI PRUNIFOLII, N. F.

Hommell, P. E.: The formula of this elixir should read: Fluid extract of viburnum prunifolium, 4 fluid ounces; compound tincture of cardamom, 2 fluid ounces; glycerin, 2 fluid ounces; and aromatic elixir, 24 fluid ounces.—Proc. New Jersey Pharm. Assoc. 1917, p. 81.

EMETINA (NONOFFICIAL COMPOUNDS).

Dale, H. H., and Dobell, Clifford: An account of some experiments on the therapeutics of amebic dysentery.—J. Pharmacol. & Exper. Therap. 1917, v. 10, p. 399–459.

Imbrie, C. G., and Roche, W.: A report on the treatment of *Amœba hystolytica* carriers with emetine bismuthous iodide.—Lancet, 1917, v. 192, p. 17.

Gepps, Margaret W., and Meakins, J. C.: The detection and treatment with emetine bismuthous iodide of amoebic dysentery carriers among cases of irritable heart.—Brit. M. J. 1917, v. 2, p. 645–648.

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Low, George C.: A report on the use of emetine bismuthous iodide in the treatment of amoebic dysentery, amoebic hepatitis, and general amoebiasis.—Lancet, 1917, v. 192, p. 482–485.

Lillie, D. G. and Shepheard, S.: A report on the treatment of *Entamoeba hystolytica* "carriers" with emetine bismuthous iodide.—Lancet, 1917, v. 193, p. 418–419.

Banks, C. et al.: A report on the treatments of 102 carriers of amebic dysentery with emetine bismuthous iodide.—Lancet, 1917, v. 193, p. 73–77.

EMETINÆ HYDROCHLORIDUM.

Méry H., and Million: An investigation of the toxicity of emetine hydrochloride. The lethal dose for rabbits by injection is given as 0.1 to 0.13 gram per kilogram. The effects of cumulative poisoning are also considered.—Compt. rend. soc. biol. 1917, v. 80, p. 592–594.

Dalimier, R.: Observations on the toxicity of emetine hydrochloride.—L'Union pharm. 1917, v. 58, p. 191; Year-Book of Pharmacy, 1917, p. 221.

Balfour, Andrew, and Pyman, Frank Lee: The toxicity of emetine, a compilation for the benefit of the medical officers serving with the British Army.—J. Roy, Army Med. Corps, 1916, v. 26, p. 35 through Chem. Abstr. 1917, v. 11, p. 171.

Pick, Ernest P. and Wasicky, Richard: A pharmacological analysis of emetine.—Physiol. Abstr. 1917, v. 2, p. 139.

Pyman, F. L., and Wenyon, C. M.: A study of the action of certain emetine derivatives on ameba.—J. Pharmacol. & Exper. Therap. 1917, v. 10, p. 237–241.

Velazco, Luis V.: A report of a case of poisoning due to the administration of emetine hydrochloride in the treatment of amebic dysentery. Gaceta Med. de Caracas, 1916, v. 23, p. 7–8 through Arch. med. et pharm. nav. 1917, v. 103, p. 390–391.

Johnson, H. H., and Murphy, J. A.: A report on the toxic effect of emetine hydrochloride observed in the treatment of 142 cases of amebic dysentery. An abstract.—J. Am. M. Assoc., 1917, v. 68, p. 313.

EMPLASTRUM BELLADONNÆ.

Dohme, A. R. L.: The committee on standards and deterioration of the American Drug Manufacturers Association finds it desirable to improve the assay method for belladonna plaster, and to determine the rate of deterioration, if any.—Prov. Am. Drug. Mfg. Assoc. 1917, p. 184.

EMPLASTRUM PLUMBI.

Wondrath, R.: Lead plaster is prepared by triturating 200 parts of li[illegible] with 25 parts of liquid paraffin, adding 500 parts of oleic

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acid, allowing the mixture to stand until the reaction is complete, and finally heating on a water bath to insure complete solution of the lead oxide.—Apoth. Ztg. through Pharm. Post, 1917, v. 50, p. 197.

EMPLASTRUM SINAPIS.

Dohme, A. R. L.: The committee on standards and deterioration of the American Drug Manufacturers' Association finds it desirable to determine the rate of deterioration, if any, of mustard plasters.—Proc. Am. Drug Mfg. Assoc. 1917, p. 184.

EMULSA.

Asher, Philip: Assay processes should be given in the U. S. P. for the emulsions of asafetida and cod-liver oil.—Am. J. Pharm. 1917, v. 89, p. 174.

Roon, Leo.: A discussion of pharmaceutical emulsions from the colloidal standpoint.—J. Am. Pharm. Assoc. 1917, .v 6, p. 263–266; J. Ind. & Eng. Chem. 1917, v. 9, p. 156–161.

Crockett, William G., and Oesper, Ralph E.: A contribution to the theory of emulsification based on pharmaceutical practice.—J. Ind. & Eng. Chem. 1917, v. 9, p. 967–969.

Stocking, Charles H.: A presentation of experimental data showing the influence of viscosity on the emulsification of oils.—J. Am. Pharm. Assoc. 1917, v. 6, p. 952–954.

Spalding, Clarence: Notes on the preparation of emulsions of hydrocarbon greases by the use of the higher alcohols as emulsifying agents.—Proc. Connecticut Pharm. Assoc. 1917, p. 61–65.

Askenasy, P.: U. S. patent No. 1234714. Emulsions are thickened by adding bead-like or globular pieces of glue or gelatin. After they have absorbed the desired amount of water they are removed from the thickened liquid.—Chem. Abstr. 1917, v. 11, p. 2603.

H. R. K.: A review of a pamphlet by Ernest Lazuech entitled "*Lois fondamentales sur les émulsions.*"—Chem. Weekblad, 1917, v. 14, p. 903.

EMULSUM AMYGDALÆ.

Hommell, P. E.: Although the emulsion of almonds is an ideal, demulcent in bronchial, laryngal, and urinary congestion, yet it is so seldom prescribed that I think the best place for it would be the N. F., and then educate the doctors to prescribe it.—Proc. New Jersey Pharm. Assoc. 1917, p. 78.

EMULSUM ASAFŒTIDÆ.

Asher, Philip: The U. S. P. should prescribe a test for the emulsion of asafetida to show that it has not been prepared from the tincture.—Am. J. Pharm. 1917, v. 89, p. 174.

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Hommell, P. E.: The emulsion of asafetida should have been placed in the N. F. It is rather a mild antispasmodic, and I believe it has seen its best days. Other agents have taken its place. A writer recently stated that the benefits derived from asafetida are due either to the alcohol contained in the preparation or to psychic influences.—Proc. New Jersey Pharm. Assoc. 1917, p. 78.

EMULSUM OLEI MORRHUÆ.

Anon: In commenting on the U. S. P. directions for the preparation of emulsion of cod liver oil, the permission to use other flavors beside methyl salicylate is criticized.—N. A. R. D. J. 1917, v. 25, p. 16.

Indiana Board of Health: Of seven samples of emulsion of cod liver oil labeled "U. S. P." the oil content varied from 18.2 to 45.6 per cent, the standard being 43 per cent by weight. The oil obtained from the low percentage product was not pure cod liver oil.—J. Am. Pharm. Assoc. 1917, v. 6, p. 409.

EMULSUM OLEI MORRHUÆ CUM CALCII LACTOPHOSPHAS, N. F.

Hommell, P. E.: The properties of the cod liver oil emulsions of the N. F. can be enhanced, also the keeping qualities, by decreasing the amount of syrup and replacing with glycerin.—Proc. New Jersey Pharm. Assoc. 1917, p. 78.

EMULSUM OLEI MORRHUÆ CUM MALTO, N. F.

Richmond, H. D., and Hitchman, F. G.: A rapid method for the determination of oil in malt and cod liver oil preparations is described. J. Soc. Chem. Ind. 1917, v. 36, p. 273.

EMULSUM OLEI RICINI, N. F.

Hommell, P. E.: The emulsion of castor oil is a failure from the standpoint of palatability and it will therefore never become popular.—Proc. New Jersey Pharm. Assoc. 1917, p. 78

EMULSUM OLEI TEREBINTHINÆ.

Hommell, P. E.: A most valuable emulsion in the U. S. P. is that of oil of turpentine. It is an ideal astringent for various forms of hemorrhage and lessens excessive secretion in bronchial troubles.—Proc. New Jersey Pharm. Assoc. 1917, p. 78.

ERGOTA.

Tschirch, A.: A hundred years of researches on ergot. A careful review of the development of chemical, biological, and pharmacological knowledge of ergot is given.—Schweiz. Apoth.-Ztg. 1917, v. 55 [illegible]09, 317–321, 330–334, 345–347, and 357–359.

[illegible].: It is to be regretted that the U. S. P. has not provided [illegible] assay for ergot, as very good results are obtained by

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the blood-pressure method, and there is considerable drug upon the market which has very little pressure activity.—J. Am. Pharm. Assoc. 1917, v. 6, p. 715.

van Leeuwen, W. S.: From biological assays of ergot preparations the author concludes that the widespread statement to the effect that these preparations deteriorate rapidly with age and are worthless after one year is not true.—Pharm. Weekblad, 1917, v. 54, p. 509–519.

Scoville, Wilbur L.: Physical appearance rather than therapeutic activity has been the main criterion thus far observed in the making of ergot preparations.—Am. Druggist, 1917, v. 65, No. 1, p. 25.

ERIODICTYON.

Farwell, Oliver Atkins: The correct authority for "*Eriodictyon Californicum* (Hooker and Arnott)" is "Torrey," not "Greene," as given in the Pharmacopœia.—Drug. Circ. 1917, v. 61, p. 174.

Dohme, A. R. L.: Yerba santa should consist of leaves only, but of late collectors are gathering twigs to such an extent that 50 per cent, more or less, of the drug consists of inert stems and twigs.—Proc. N. W. D. A. 1917, p. 514.

EUCALYPTOL.

Ducung and Moreau: Notes on tests for the detection of the adulteration of eucalyptol.—Bull. Soc. pharm. Bordeaux, 1917, v. 55, p. 348–349.

EUCALYPTUS.

Farwell, Oliver Atkins: The specific name "*globulus*" should not be capitalized as in the U. S. P., because it is not a proper name.—Drug. Circ. 1917, v. 61, p. 174.

EUONYMUS, N. F.

Farwell, Oliver Atkins: The proper spelling for the generic name of wahoo is *Euonymus*.—Drug. Circ. 1917, v. 61, p. 230.

EUPHORBIA PILULIFERA, N. F.

Farwell, Oliver Atkins: The proper name for the plant from which this drug is produced is *Euphorbia hirta* Linné; but if considered as a genus distinct from true *Euphorbia*, *Chamaesyce hirta* (Linné) Millspaugh.—Drug. Circ. 1917, v. 61, p. 230.

EXTRACTA.

Beringer, George M.: The introduction of a number of new powdered extracts into the U. S. P. was necessary on account of the popularity of this class of preparations.—Am. J. Pharm. 1917, v. 89, p. 15.

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Lyubimenko: The loss of color of extracts of green leaves exposed to the action of air and light, is due to a change in th librium between the action of an antioxidase, which protects phyll from the influence of light and oxygen, and the actic peroxidase of the tissues, which rapidly destroys chlorophyll.—I pharm. through Giorn, farm. chim. 1917, v. 66. p. 288–289.

Bouvet, M.: The caffein content requirement of the Ph. Fr. kola extract should be reduced to 8 per cent, as none of th mercial samples contain 10 per cent.—Bull. sc. pharmacol. 1 24, p. 295–297.

EXTRACTUM ACONITI.

Dohme, A. R. L.: The extract of aconite root is of little va the alkaloids are apparently hydrolized or destroyed by the of concentration, even if this is carried out in a vacuum app Physiological tests show that the extract deteriorates rapid in two months retains less than 3 per cent of its initial acti Proc. Am. Drug Mfg. Assoc. 1917, p. 183.

Saní, Luigi: A discussion of methods for the assay of ext aconite.—Boll. chim.-farm. 1917, v. 56, p. 497–498.

EXTRACTUM ALOES, N. F.

Madsen, E. H.: From experiments the author concludes tl Ph. Dan. method for the preparation of the extract of aloes i factory. He emphasizes the value of the low temperature making the extraction.—Archiv. Pharm. Chem. 1917, v. 24, p.

EXTRACTUM BELLADONNÆ FOLIORUM.

Rasmussen, H. B.: A note on the application of the silicotu method of determining atropine to the analysis of belladon tracts.—Ber. deutsch. pharm. Gesellsch. 1917, v. 27, p. 1 through J. Soc. Chem. Ind. 1917, v. 36, p. 734.

EXTRACTUM CANNABIS.

Dohme, A. R. L.: *Cannabis americana* is not efficient, alth is now official. Furthermore, there is no standard upon wl base the physiological test. Until these two defects are elim a standard and efficient cannabis extract is not likely to be prod Proc. N. W. D. A. 1917, p. 502.

EXTRACTUM CARNIS, N. F.

Waser, Ernst: A description of a method for the detection termination of formic acid in meat extract.—J. Chem. Soc. 1917, v. 112, No. 2, p. 343.

Patch, E. L.: Five samples of beef extract examined ra protein content from 46.45 to 55 per cent; in water content f ent; in sodium chloride content from 4 to 6.63 per n. Assoc. 1917, v. 6, p. 311.

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EXTRACTUM CINCHONÆ, N. F.

Anon.: Data showing the necessity for using sawdust in the assay of the solid extract of cinchona are given.—Drug. Circ. 1917, v. 61. No. 8, p. 25.

Santí, Luigi: A discussion of methods for the assay of extract of cinchona. The method of E. Marck is described in detail.—Boll, chim.-farm. 1917, v. 56, p. 500.

EXTRACTUM COLOCYNTHIDIS.

Santí, Luigi: A method for the assay of the extract of colocynth is described and discussed.—Boll. chim.-farm. 1917, v. 56, p. 520–521.

EXTRACTUM CONII, N. F.

Santí, Luigi: A description of Kremel's method for the assay of extract of conium; also a reference to the method of Snow.—Boll. chim.-farm. 1917, v. 56, p. 498.

EXTRACTUM ERGOTÆ.

Beringer, George M.: In order to obtain a smooth homogeneous extract, the U. S. P., IX, directs that the oil be removed from the ergot by purified petroleum benzin before the drug is percolated with the alcoholic menstruum.—Am. J. Pharm. 1917, v. 89, p. 17.

Santí, Luigi: Keller's method for the estimation of cornutine in the extract of ergot is described.—Boll. chim.-farm. 1917, v. 56, p. 519.

EXTRACTUM ERGOTÆ AQUOSUM, N. F.

Rusby, H. H.: An alcoholic extract of ergot is official in the U. S. P., and there is an aqueous extract official in the N. F. If there is an aqueous extract that is fit to be used and is a good thing, why shouldn't it be in both books?—Proc. Am. Drug Mfg. Assoc. 1917, p. 11.

EXTRACTUM FERRI POMATUM, N. F.

Santí, Luigi: A method for the determination of iron in the ferrated extract of apples is described.—Boll. chim.-farm. 1917, v. 56, p. 521.

EXTRACTUM GLYCYRRHIZÆ.

van der Haar, A. W.: In a report on the analyses of chemicals in Holland during the past few years it is stated that much of the extract of licorice is of poor quality, some containing less than 20 per cent of glycyrrhizin and some being rich in asparagin.—Pharm. Weekblad, 1917, v. 54, p. 256.

Santí, Luigi: A method for the determination of the glycyrrhizin in the extract of licorice is described.—Boll. chim.-farm. 1917, v. 56, p. 521.

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Kreis: A sample of licorice sticks of Italian origin was fou consist of wheat flour, rice flour, glue, and a small amount of l juice.—Schweiz. Apoth.-Ztg. 1917, v. 55, p. 641.

EXTRACTUM GLYCYRRHIZÆ PURUM.

Beringer, George M.: The purpose of the use of chloroform in the preparation of the pure extract of glycyrrhiza is to p decomposition in the drug and the percolate during warm weat Am. J. Pharm. 1917, v. 89, p. 17.

EXTRACTUM HYDRASTIS.

Beringer, George M.: The addition of tartaric acid to the struum used for percolating hydrastis is for the purpose of aic the exhaustion of the drug.—Am. J. Pharm. 1917, v. 89, p. 17

EXTRACTUM HYOSCYAMI.

Santí, Luigi: A discussion of methods for the assay of extı hyoscyamus.—Boll chim.-farm. 1917, v. 56, p. 497–498.

Van Itallie, E. I., and Woutman, W. F.: An investigation mixture of salts obtained in the preparation of the extract of cyamus.—Pharm. Weekblad, 1917, v. 54, p. 659–661.

EXTRACTUM NUCIS VOMICÆ.

Santí, Luigi: A discussion of methods for the assay of extı nux vomica.—Boll. chim.-farm. 1917, v. 56, p. 499–500.

EXTRACTUM OPII.

Heiauschka, A., and Schmid, J.: Analytical data showing t content, alkaloidal content, etc., of a number of different sam extract of opium.—Arch. pharm. 1916, through Pharm. Wee 1917, v. 54, p. 1027.

Santí, Luigi: A discussion of methods for the assay of extı opium.—Boll. chim.-farm. 1917, v. 56, p. 498–499.

EXTRACTUM QUASSIÆ, N. F.

Santí, Luigi: A method for the determination of quassin extract of quassia is described.—Boll. chim.-farm. 1917, v. 56,

FERRI CARBONAS SACCHARATUS.

Asher, Philip: An explanation of the chemistry of the U. IX, method for the assay of saccharated ferrous carbonate.— Pharm. 1917, v. 89, p. 171.

FERRI CHLORIDUM.

Duncan, William: A discussion of the proper method of pounding a prescription of ferric chloride and sodium sal mix[illegible]rder to avoid the formation of a precipitate.—Pha 1[illegible]236, 239.

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Forster, Aquila, et al.: A study of certain combinations of ferric chloride with ether and with dibenzyl sulphide.—J. Chem. Soc. Lond. 1917, v. 111, p. 809–814.

FERRI SULPHAS.

Pérégrin: An economic method for the manufacture of ferrous and ferric sulphates is described.—Rev. chim. industrielle, 1917, v. 26, p. 182.

FERRUM.

Ruer, R., and Goerens, F.: A study of the polymorphic transformations of pure iron.—Ferrum, v. 13, p. 1–6, through J. Chem. Soc. Lond. 1916, v. 110, part 2, p. 483–484.

Smits, A., and Lobry de Bruyn, C. A.: A new method for the passivification of iron consists in covering iron electrodes sealed into glass tubes with a solution of ferric nitrate.—Proc. Acad. Sci. Amsterdam, 1917, v. 19, p. 880–884, through Chem. Abstr. 1917, v. 11, p. 2993.

Berg, R.: Methods for determining small quantities of iron and aluminum in foods are described.—Chem. Ztg. 1917, v. 41, p. 50–52, through J. Soc. Chem. Ind. 1917, v. 36, p. 231.

Darling, E. R.: A colorimetric method for the rapid determination of iron in salts of antimony is described. The color is formed by means of KCNS.—Chem. Analyst, 1917, v. 20, p. 20–21.

Palkin, Samuel: A description of a method for the separation of aluminum from iron based on the solubility of ferric chloride in ether.—J. Ind. & Eng. Chem. 1917, v. 9, p. 951–953.

FERRUM REDUCTUM.

Dohme, A. R. L.: The committee on standards and deterioration of the American Drug Manufacturers' Association finds it desirable to determine whether or not the U. S. P. test for reduced iron needs revision. It is stated that reduced iron is seldom free from sulphides.—Proc. Am. Drug. Mfg. Assoc. 1917, p. 184.

Winkler, L. W.: The quantity of metallic iron in iron reduced by hydrogen may be determined approximately (within 0.5 per cent) by simple ignition in the air. One hundred parts by weight of iron give 142.9 parts of Fe_2O_3.—Ztschr. angew. Chem. 1917, v. 30, part 1, p. 64, through J. Chem. Soc. 1917, v. 112, part 2, p. 511.

Scoville, W. L.: One sample of reduced iron examined contained only 60 per cent of iron.—J. Am. Pharm. Assoc. 1917, v. 6, p. 411.

FLUIDEXTRACTA.

Buhrer, C.: A discussion of precipitation phenomena in fluid extracts and of the causes producing the same.—Schweiz. Apoth.-Ztg. 1917, v. 55, p. 4–7.

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Congdon, Leon A.: Drug inspection in Kansas showed the foll fluid extracts to be deteriorated in some instances: Fluid extr stillingia, kino, senna, wild cherry, kola, digitalis, pink root, rhu catechu, and gentian. Data showing the specific gravity, perce of solids, and alcohol content of a number of fluid extracts exa are also given.—Proc. Kansas Pharm. Assoc. 1917, p. 88–89.

Dilly, O. C.: Data are given showing the changes which had place in a number of fluid extracts prepared by C. Lewis Diehl years 1880 and 1881.—Proc. Kentucky Pharm. Assoc. 1917, p. 9(

Hommell, P. E.: The fluid extracts of aralia, asclepias, cornus, corydalis, dulcamara, galega, helianthemum, juglans trillium should have been omitted from the N. F.—Proc. New Pharm. Assoc. 1917, p. 82.

Sayre et al.: Analytical data are given showing the specific gr percentage of alcohol, solids per 100 cubic centimeters, and alka content of old fluid extracts of mullein leaves, blue flag, cotto bark, dogwood, stillingia, boneset, and guarana.—Rep. Kansa Health, 1916, v. 12, p. 433.

FLUIDEXTRACTUM ACONITI.

Dohme, A. R. L.: The use of cochineal as an indicator i estimation of the ether-soluble alkaloids in fluid extract of a should be discontinued, as it gives results which are too high. M red is the indicator recommended for use in this assay. The extract deteriorates to some extent within two months.—Proc Drug. Mfg. Assoc. 1917, p. 183.

FLUIDEXTRACTUM CALUMBÆ, N. F.

Hommell, P. E.: The dose of fluid extract of calumba given N. F. is 30 minims. About one dose of this size would be al any human being could take in one day.—Proc. New Jersey P Assoc. 1917, p. 82.

FLUIDEXTRACTUM CASCARÆ SAGRADÆ AROMATICUM.

Rippetoe, J. R.: This preparation still remains one of the m specimens. It is no doubt a fair estimate to say that for every gallons used not more than 1 is made according to the formula. Glycerin has no value as a solvent, and as a swee agent sugar is better and much cheaper.—Drug. Circ. 1917, p. 501; J. Am. Pharm. Assoc. 1917, v. 6, p. 464.

FLUIDEXTRACTUM CATARIÆ, N. F.

Hommell, P. E.: The dose of fluid extract of catnip given N. [illegible] fluiddrachm. One-quarter or one-half the dose is [illegible] New Jersey Pharm. Assoc. 1917, p. 82.

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FLUIDEXTRACTUM CINCHONÆ.

Beringer, George M.: Hydrochloric acid is added to the menstruum employed in the preparation of the fluid extract of cinchona in order to insure the complete extraction of alkaloids.—Am. J. Pharm. 1917, v. 89, p. 19.

Chick, Oliver: A paper dealing with the preparation of *extractum cinchonæ liquidum*, Ph. Brit. The assay process of the 1898 Ph. Brit. is stated to be more accurate than that of the 1914 edition.—Chem. & Drug. 1917, v. 89, p. 612.

FLUIDEXTRACTUM CONDURANGO, N. F.

Hommell, P. E.: The dose of the fluid extract of condurango given in the N. F. is 1 fluiddrachm. It should be reduced to 30 drops, as few physicians prescribe more.—Proc. New Jersey Pharm. Assoc. 1917, p. 82.

FLUIDEXTRACTUM CONII, N. F.

Anon.: The H. K. Mulford Co. reports that sulphuric acid is preferable to acetic acid in the preparation of fluid extract of conium. Coniine is a volatile alkaloid and coniine acetate is also volatile, whereas coniine sulphate produced by the use of sulphuric acid would be stable and therefore yield a better preparation.—Drug. Circ. 1917, v. 61, No. 4, p. 25.

FLUIDEXTRACTUM DIGITALIS.

Beringer, George M.: The alcoholic strength of the menstruum directed to be used in making the fluid extract of digitalis has been increased in order to impart greater stability to the preparation.—Am. J. Pharm. 1917, v. 89, p. 19.

FLUIDEXTRACTUM DULCAMARÆ, N. F.

Hommell, P. E.: Fifteen to 30 drops of fluid extract of dulcamara would be a good average dose, not 1 fluiddrachm, as given in the N. F.—Proc. New Jersey Pharm. Assoc. 1917, p. 82.

FLUIDEXTRACTUM ERGOTÆ.

Beringer, George M.: In the directions for the preparation of the fluid extract of ergot the revision committee has returned to the recommendation of Dr. E. R. Squibb, and the Pharmacopœia now specifies the use of hydrochloric acid in the menstruum used for exhausting the drug.—Am. J. Pharm. 1917, v. 89, p. 19.

Maben, Thomas: Surprise is expressed at the fact that the new edition of the U. S. P. required no physiological test for this preparation, and that no statements concerning the precautions to be observed in its preservation are given.—Chem. & Drug. 1917, No. 1931, p. 71.

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FLUIDEXTRACTUM FRANGULÆ.

Richter, Ernst: Data showing the yield of extractive matt emodin content of fluid extract of frangula are presented.—A Ztg. 1917, v. 32, p. 63, through Ztschr. angew. Chem. 1917, part 1, p. 174.

FLUIDEXTRACTUM HYDRASTIS.

Santí, Luigi: The methods of Beckurts and Schulze and of H for the assay of fluid extract of hydrastis are described in Reference is also made to the work of Heyl and of van der E determine the suitability of these methods.—Boll. chim.-farm v. 56, p. 518–519.

FLUIDEXTRACTUM IPECACUANHÆ.

Snyder, J. P.: The new alcohol menstruum of the U. S. P., not nearly as satisfactory for exhausting ipecac as the menstru the U. S. P., VIII; in fact, the former fails to extract but littl than 75 per cent of the alkaloid, and with an expensive dru ipecac this becomes a very important item.—J. Am. Pharm. 1917, v. 6, p. 713.

Beringer, George M.: By the use of a menstruum consist diluted hydrochloric acid, alcohol, and water an attempt ha made to produce a fluid extract of ipecac from which a syrup made by a simple admixture, instead of by the roundabout p directed in the U. S. P., VIII.—Am. J. Pharm. 1917, v. 89, p.

Dohme, A. R. L.: A decided blunder was made by the r committee in fixing the standard for the fluid extract of ipec per cent of alkaloid. If one part of a finished fluid extract is resent one part of crude drug it is self-evident that you c obtain a 2 per cent fluid extract from a drug containing onl per cent of alkaloid.—Proc. N. W. D. A. 1917, p. 504.

Maben, Thomas: Attention is directed to the fact that the U requires that the fluid extract must contain not less than 1.8 no than 2.2 per cent of alkaloids, whereas the drug is required t not less than 1.75 per cent of alkaloids.—Chem. & Drug. 1917, No. 1931, p. 71.

Rippetoe, J. R.: Ipecac is required to yield not less than 1. cent of the ether-soluble alkaloids of ipecac. To be consiste Pharmacopœia should require that the fluid extract should yi less than 1.5 nor more than 1.75 grams of ether-soluble alkal ipecac.—Drug. Circ. 1917, v. 61, p. 501–502; J. Am. Pharm. 1917, v. 6, p. 464.

Santí, Luigi: A description of Keller's method for the dete tion [illegible]tine in the fluid extract of ipecac.—Boll. chim.-farm v

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FLUIDEXTRACTUM KOLÆ, N. F.

Santí, Luigi: A description of a method for the determination of caffeine in the fluid extract of kola nuts.—Boll. chim.-farm. 1917, v. 56, p. 517–518.

FLUIDEXTRACTUM NUCIS VOMICÆ.

Beringer, George M.: By the omission of acetic acid from the menstruum employed in exhausting nux vomica as directed in the U. S. P., IX, a fluid extract is obtained which is less prone to form a precipitate on standing.—Am. J. Pharm. 1917, v. 89, p. 20.

Blosmo, O. J.: Results showing the alkaloidal content of different fractions of the percolate from nux vomica are given. The assays were made according to the U. S. P. method and the methods of LaWall and Sayre.—Proc. Minnesota Pharm. Assoc. 1917, p. 145–150.

FLUIDEXTRACTUM SABAL.

Griebel, C.: Analytical data showing the constituents of fluid extract of saw palmetto.—Chem. Abstr. 1917, v. 11, p. 1152 from Apoth.-Ztg. 1916, v. 31, p. 306.

FLUIDEXTRACTUM SCILLÆ.

Beringer, George M.: The changes in the process for the preparation of fluid extract of squill were made for the purpose of getting rid of the large amounts of gum and sugar, and thereby insuring a more permanent preparation.—Am. J. Pharm. 1917, v. 89, p. 21.

FLUIDEXTRACTUM SENEGÆ.

Beringer, George M.: In the preparation of the fluid extract of senega ammonia water has been substituted for the solution of potassium hydroxide, as the former is superior to the latter in preventing precipitation and gelatinization in the finished product.—Am. J. Pharm. 1917, v. 89, p. 21.

FLUIDEXTRACTUM SENNÆ.

Rippetoe, J. R.: Both of the official varieties of senna should be permitted to be used in all of the official preparations of senna, including the fluid extract.—Drug. Circ. 1917, v. 61, p. 502; J. Am. Pharm. Assoc. 1917, v. 6, p. 464.

FLUIDEXTRACTUM VALERIANÆ, N. F.

Hommell, P. E.: The dose of the fluid extract of valerian is given in the N. F. as 30 minims. One-half of this amount would be sufficient.—Proc. New Jersey Pharm. Assoc. 1917, p. 82.

FLUIDGLYCERATA, N. F.

Brown, L. A.: Fluid glycerates are a new class of preparations, in the N. F., IV, and contain 50 per cent of glycerin in place of alcohol,

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each mil being made to represent 1 gram of the drug. T glycerates of cascara sagrada, aromatic cascara sagrada, glyc krameria, and rhubarb are official.—Bull. Kentucky Agric. Sta. 1917, Feb. 15, p. 38.

Smith, F. A. Upshur: Fluid glycerates are a newly introduc of preparations due largely to the labors of Beringer in this and Martindale in England. They are made with glycerin an and are usually miscible with water.—Proc. Minnesota Pharm 1917, p. 172.

FOENICULUM.

Farwell, Oliver Atkins: The correct name for the source drug is *Fœniculum Fœniculum* (Linné) Karsten.—Drug. Cir v. 61, p. 174.

Rusby, H. H.: A great amount of fennel of poor quality rived during the past year and has found its way into th facture of veterinary remedies.—J. Am. Pharm. Assoc. 191 p. 409.

Roberts, J. G.: One rejected sample of fennel seed conta per cent of stems and foreign seeds, 13.7 per cent of smal and 0.014 per cent of fecal matter. The ash yield was 27.4 which is more than three times as much as the U. S. P. sta 9 per cent.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 85.

FRANGULA.

Beal, George D., and Okey, Ruth: A description of a me the qualitative identification of the drugs containing emc Am. Chem. Soc. 1917, v. 39, p. 716–725.

GALEGA, N. F.

Lewis, Marian, and Carlson, A. J.: From experiments on c goats it is concluded that *Galega officinalis* has no benefici on lactation.—J. Am. M. Assoc. 1917, v. 68, p. 1570–1572.

GALLA.

Anon.: Secretary of Commerce Redfield has announced t sources of oak galls have recently been found near the Bair station in California.—Pharm. Era, 1917, v. 50, p. 179.

Roberts, J. G.: In three samples of galls examined the f amounts of gallotannic were found: Chinese, 63.2 per cent; 38.1 per cent; and Morea, 51 per cent.—Proc. Pennsylvania Assoc. 1917, p. 85.

GAMBIR.

Roberts, J. G.: One lot of gambir examined was rejected a pasty condition, instead of dry, as required by t Pennsylvania Pharm. Assoc. 1917, p. 85.

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GELATINUM.

Schwerin, B.: U. S. patent No. 1235064 describes an electro-osmotic method for the purification of gelatin.—Chem. Abstr. 1917, v. 11, p. 2625.

Biltz, W., et al.: Data relative to the molecular size of gelatin as shown by osmotic pressure determinations are presented.—Ztschr. physik. Chem. 1916, v. 91, p. 705–712, through J. Soc. Chem. Ind. 1917, v. 26, p. 297.

Rakuzin, M. A., and Braudo, Ek. Maks.: Researches on the optical rotation of alkali glutinates. The chemistry of α- and β-gelatin.—J. Russ. Phys. Chem. Soc. 1916, v. 48, p. 269–272, through Chem. Abstr. 1917, v. 11, p. 582.

Dohme, A. R. L.: Several samples of gelatin examined contained an excess of arsenic and ash.—Proc. N. W. D. A. 1917, p. 506.

Lea, E. J.: The majority of eight samples of gelatin examined contained excessive glue, arsenic, or zinc.—Bull. California Bd. Health, 1917, v. 13, p. 236.

McGill, A.: A report of analytical data obtained in the examination of 137 samples of gelatin.—Bull. Lab. Inl. Rev. Dept. Canada, 1917, No. 367, p. 4.

Anon.: Notice of judgment No. 4524 relates to the adulteration of gelatin.—S. R. A.-Chem. 1917, p. 38.

Choay, E.: A discussion of the method of preparation and the properties of tannate of gelatin.—J. pharm. et chim. 1917, v. 16, p. 137–139.

GELSEMIUM.

Farwell, Oliver Atkins: The proper authority for the binomial "*Gelsemium sempervirens* (Linné)" is "Persoon," not "Aiton filius."—Drug. Circ. 1917, v. 61, p. 174.

Scoville, Wilbur L.: Manufacturers are already standardizing gelsemium and its preparations by assay, but no assay for this purpose has been included in the Pharmacopœia to date.—Am. Druggist, 1917, v. 65, No. 1, p. 26.

Dohme, A. R. L.: One lot of gelsemium root examined did not comply with the U. S. P. description in that they were entirely too large.—Proc. N. W. D. A. 1917, p. 520.

Roberts, J. G.: The only lot of gelsemium root examined contained 0.25 per cent of alkaloids.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 85.

GENTIANA.

Tunmann, O.: A note on the occurrence of *Picea excelsa* as an adulterant of powdered gentian.—Apoth.-Ztg. 1917, p. 181, through Pharm. Weekblad, 1917, v. 54, p. 1427.

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GLUCOSUM.

Burmann, James: A description of a rapid and accurate r
for the quantitative determination of glucose.—Schweiz. Apot
1917, v. 55, p. 196–199.

Cowie, W. B.: Notes on the effect of using commercial glu
certain pharmaceutical preparations. The bad effects are st
be due to the SO_2 contained in commercial glucose.—Phs
1917, v. 98, p. 235–236.

Kling, André: For the detection and estimation of arsenic i
mercial glucose, the Marsh, Gutzeit, and diaphanometric (tu
obtained with sodium hypophosphite in sulphuric acid so
methods are equally trustworthy.—Ann. Falsif. 1917, v. 10,
450.

GLYCERINUM.

Wolff, Hans: The use of the refractometer for differentiat
tween glycerol and ethylene glycol is recommended. The
tometer number of ethylene glycol is less than 15, while
glycerol is more than 55.—Chem. Ztg. 1917, v. 41, p. 608–609, t
J. Chem. Soc. Lond. 1917, v. 112, part 2, p. 512–523.

Briggs, C. H.: A description of a method for the quant
determination of glycerin in pharmaceutical preparations
glycerin is recovered by distillation and weighed in the anh
state.—Rev. farm. 1916, No. 3, through Ann. Falsif. 1917,
p. 250.

Löfel, K.: Brief descriptions of methods which have been em
for the estimation of glycerol. The descriptions include p
methods (distillation, refraction, specific gravity, vapor pressur
oxidation methods (with permanganate or dichromate), esteri
methods (benzoate, acetin, iodide), and other methods, such a
in which the glycerol is weighed as glyceryl nitrate or sodium
ate.—Ztschr. angew. Chem. 1917, v. 30, part 1, p. 197–200, t
J. Chem. Soc. Lond. 1917, v. 112, part 2, p. 547.

Neumann, R.: A report on the estimation of glycerol by the
method, using small quantities of hydriodic acid (semimicro
method). The author finds that this method yields trust
results when only about one-tenth of the usual quantities of
and reagents are employed.—Ztschr. angew. Chem. 1917, v
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glycerin.—Am. Perf. 1917, v. 12, p. 281–282.

[illegible] B.: Attention is called to an error in F. P.
[illegible] quantitative determination of glycerin as pu
[illegible]harm. Assoc., January, 1915.—J. Am. Pharm.
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Flarity, James: A report of an incompatibility in a prescription containing, among other ingredients, solution of hydrogen dioxide and glycerin. The hydrogen dioxide reacts with the glycerin, forming oxalic acid.—Proc. Wisconsin Pharm. Assoc. 1917, p. 113.

Patch, E. L.: One lot of glycerin examined contained a minute trace of arsenic; another lot had a specific gravity of only 1.247.—J. Am. Pharm. Assoc. 1917, v. 6, p. 410.

Baird, R. O.: Of 24 samples of glycerin examined, only two were below the U. S. P. standard.—Bull. North Dakota Exper. Sta. F. Dept. 1917, v. 4, p. 389.

McGill, A.: Of 230 samples of glycerin examined, 36 were below standard.—Bull. Lab. Inl. Rev. Canada, 1917, No. 370, p. 3.

Engelhardt, H.: A list of German substitutes for glycerin, with directions for preparing the same.—J. Am. Pharm. Assoc. 1917, v. 6, p. 57.

Alther: A note on the composition of "glyzerite," a substitute for glycerin.—Schweiz. Apoth.-Ztg. 1916, v. 54, p. 225–226.

Anon.: Descriptions of a number of glycerin substitutes.—Pharm. Ztg. 1917, v. 62, p. 61, 99, and 105, through Ztschr. angew. Chem. 1917, v. 30, part 1, p. 175.

Dinkler and Schaumann: A discussion of experiments to determine to what extent perkaglycerol can be used pharmaceutically in place of glycerin.—Pharm. Ztg. 1916, v. 61, p. 503, through Chem. Abstr. 1917, v. 11, p. 1720.

Lennox, J.: A description of an efficient substitute for glycerin prepared from Irish moss.—Pharm. J. 1917, v. 98, p. 186.

GLYCERITA.

Asher, Philip: The U. S. P. should prescribe assay methods for the glycerites of boroglycerine and tannin.—Am. J. Pharm. 1917, v. 89, p. 174.

GLYCYRRHIZA.

Farwell, Oliver Atkins: The designation *Glycyrrhiza glabra* Linné is sufficient to indicate the source for Spanish licorice. "(Waldstein et Kitaibel)" should be inserted between "*glandulifera*" and "Regal et Herder" in order to make the author's citation perfect.—Drug. Circ. 1917, v. 61, p. 174.

Anon.: Statistics showing the amount of licorice root and paste shipped into the United States from Spain during the years 1914 to 1916 are given.—Oil, Paint & Drug Rep., 1917, v. 91, No. 22, p. 72.

Anon.: According to the Weekly Bulletin, Canadian Department of Trade and Commerce, Russia supplies practically the whole of the

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Hurst, Carl B.: Spanish customhouse management gives the fo lowing quantities of licorice in metric tons exported to all countri during the first 11 months of 1916: Total of 3,052 tons of licori root and 5,048 tons of licorice extract and paste.—Com. Rep. 191 No. 108, p. 516.

Linz, A.: A comparison of methods for the estimation of glycy rhizin in licorice root and in *Succus Liquiritiæ*. Twenty-seven diffe ent methods were investigated and a new method described. tabulated list of the literature on the subject from 1808 to 1913 appended.—Arch. Pharm. 1916, v. 254, p. 65–134 and 204–22 through Analyst, 1917, v. 42, p. 359.

Dohme, A. R. L.: Many samples of licorice root examined contain large tasteless and dirty roots. Even a sample of licorice peeling a by-product in the manufacture of peeled licorice, was offered Spanish licorice root.—Proc. N. W. D. A. 1917, p. 513, 520.

Roberts, J. G.: Two shipments of licorice root received contain a very large proportion of moist roots.—Proc. Pennsylvania Phar Assoc. 1917, p. 85.

GOSSYPII CORTEX, N. F.

Farwell, Oliver Atkins: In *Gossypium Barbadense* Linné, t specific name, a geographical one, is capitalized, as it should be; b this is an oversight of the proof reader, as the intention was decapitalize all such names. They should be recapitalized.—Dru Circ. 1917, v. 61, p. 230.

GOSSYPIUM PURIFICATUM.

Lahache: A discussion of methods for the evaluation of cott intended for use in the preparation of bandages and surgical dressing An abstract.—Giorn. farm. chim. 1917, v. 66, p. 164–169, 197–20

GRANATUM.

Hess, K., and Etchel, A.: Researches on the chemical constituti of the alkaloids of pomegranate.—Ber. deutsch. chem. Gesellsc 1917, v. 50, p. 368, 1192, and 1386, through Pharm. Weekblad, 191 v. 54, p. 1456–1458.

GRINDELIA.

Penick, S. B.: Grindelia is described in the U. S. P. as "the dri leaves and flowering tops of *Grindelia camporum* Greene, or *Grindel cuneifolia* Nuttall, or *Grindelia squarrosa* (Pursh) Dunal, without t presence or admixture of more than 10 per cent of stems or oth foreign matter." In the flowering tops there must be some ste

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which would possibly be 10 per cent of the total, so that no more stem can be present if the drug strictly conforms to requirements. None of this drug will, therefore, be found on the market within 50 per cent of the U. S. P. requirements.—J. Am. Pharm. Assoc. 1917, v. 6, p. 696.

GUAIACOL.

Palet, Luciano P. J.: Notes on the use of enzymes for the differentiation of guaiacol and creosote. Dilute alcoholic solutions of guaiacol treated with an oxidase give a yellow color, which gradually changes to orange. Under the same conditions, dilute solutions of beech creosote give a light violet color after one-half hour.—Anales soc. quim. Argentina, 1917, v. 5, p. 305–307.

Roberts, J. G.: One lot of guaiacol examined contained oily hydrocarbons and other impurities.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 85.

Menciére, Louis: Notes on the physiological properties of guaiacol and benzoic acid, and on the use of these substances in medicine and surgery.—Compt. rend. acad. sc. 1917, v. 165, p. 1023–1025.

GUAIACUM.

Dohme, A. R. L.: Samples of guaiac examined varied from 75.6 per cent to 91.6 per cent in alcohol-soluble material.—Proc. N. W. D. A. 1917, p. 509, 515.

Scoville, W. L.: Of three samples of guaiac examined, one was worthless, one contained 63.4 per cent of resin soluble in alcohol, and four contained from 80 to 91.25 per cent of alcohol-soluble resin.—J. Am. Pharm. Assoc. 1917, v. 6, p. 410.

GUARANA.

Scoville, W. L.: A sample of guarana examined assayed 4.32 per cent of caffeine.—J. Am. Pharm. Assoc. 1917, v. 6, p. 410.

HELONIAS, N. F.

Moser, John: A descriptive article on the pharmacognosy of helonias, with a number of illustrations, including photographs of the several types of helonias rhizome and cross sections thereof.—Am. J. Pharm. 1917, v. 89, p. 291–296.

HEXAMETHYLENAMINA.

Markessen: A description of a method for the preparation of hexamethylentetramine by the pharmacist.—Farmacevtisk Revy, 1916, No. 11, p. 190, through Schweiz, Apoth.—Ztg. 1917, v. 55, p. 227.

Carles, P.: Reactions for the identification of urotropine are described.—Ann. chim. analyt, 1917, v. 22, p. 8–9.

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Cazzani, Ugo: Notes on hexamethylenamine, tests for ide and impurities, quantitative determination, incompatibilities, Boll. chim.-farm. 1917, v. 56, p. 164–165.

Howell, E. V., and Keyser, E. V.: A general discussion c chemical properties and therapeutic uses of hexamethylenami J. Am. Pharm. Assoc. 1917, v. 6, p. 445–451.

Vivario, R., and Wagenaar, M.: Descriptions of crystalline d tives formed by urotropin with metallic salts, with a summa the literature. The application of this data to microche methods is discussed.—Pharm. Weekblad, 1917, v. 54, p. 157

Leuieur, A.; A description of the method of preparation an properties of hexamethylene peroxide of hydrogen—a comp obtained by the action of hydrogen peroxide upon hexamethyl mine.—J. pharm. et chim. 1917, v. 15, p. 222–229.

Remele: A report of researches dealing with the passage of tropine into the aqueous humor and the separation of formald which occurs thereon.—Chem. Abstr. 1917, v. 11, p. 997.

HUMULUS.

Salmon, E. S.: A detailed account of hop-breeding experi conducted at Wye College, Kent.—J. Inst. Brewing, 1917, p. 60–82, through Chem. Abstr. 1917, v. 11, p. 1878.

Benjamin, G. H.: U. S. patent No. 1226052 described the d of hops by means of air heated to 50° C. for 1 to 2 hours, then 6 C. for 2 to 5 hours, and finally at 77° C. for 30 to 60 minutes.—(Abstr. 1917, v. 11, p. 2257.

Anon.: Recent investigations by specialists of the United S Department of Agriculture, reported in bulletin 568, establishe fact that the use of impure sulphur in bleaching hops is the s of the arsenic with which they are sometimes contaminated. Paint & Drug Rep. 1917, v. 92, No. 12, p. 50K.

HYDRARGYRI CHLORIDUM CORROSIVUM.

Marden, J. W., and Dover, Mary V.: Data relative to the bility of mercuric chloride in chloroform-ether, acetone-benzen ethyl acetate-benzene mixtures are presented.—J. Am. Chem 1917, v. 39, p. 1–7.

Adanti, Guido: A volumetric method for the determinati mercury salts, and its application to the testing of mercuric ch compresses is described.—Boll. chim.-farm. 1916, v. 55, p. 55

Azzi, Azzo: Histological descriptions of changes in the kidn poisoning by mercuric chloride, potassium dichromate, and car ides.—Arch. sci. med. 1917, v. 40, p. 125–127.

Hinsdale, Albert E., and Hadley, R. V.: Descriptions o histological changes produced in the lungs and livers of guine

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Anon.: An editorial dealing with the growing frequency of mercurial poisoning.—J. Am. M. Assoc. 1917, v. 68, p. 1987–1988.

DeM. Sajous, Louis: A discussion of methods for the treatment of acute mercuric chloride poisoning.—New York, M. J. 1917, v. 106, p. 1146–1147, 1192–1193, 1234–1235.

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Brown, George E., and Baskett, L. W.: A report of a case of mercuric chloride poisoning with special reference to the employment of the Lambert treatment.—J. Am. M. Assoc. 1917, v. 68, p. 1622.

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Linhart, G. A., and Adams, E. Q.: An explanation of the reduction of mercuric chloride by phosphorus acid.—J. Am. Chem. Soc. 1917, v. 39, p. 948–950.

Hall: The following is recommended as an antidote for poisoning with mercuric chloride: Potassium iodide, 0.5 gram; quinine hydrochloride, 0.3 gram; and water, 125 grams.—Pharm. Post, 1916, p. 729, through Schweiz. Apoth.-Ztg. 1917, v. 55, p. 419.

Wilms, J. H.: Notes on calcium sulphide as a chemical and clinical antidote for mercuric chloride poisoning, with experiments and case reports.—J. Lab. & Clin. Med., 1916–1917, v. 2, p. 445–458.

Haskell, C. C., and Courtney, R. H.: An investigation of the value of intravenous injections of solutions of calcium sulphide in the treatment of poisoning by mercuric chloride. It is concluded that the injection of calcium sulphide is dangerous, and that death may be hastened rather than retarded by this procedure.—J. Lab. & Clin. Med. 1917, v. 3, p. 110–114.

Linhart, G. A.: A method for the preparation of pure sodium phosphate for use as an antidote for mercuric chloride poisoning is described in detail.—J. Lab. & Clin. Med. 1916–1917, v. 2, p. 722–725.

Weiss, H. B.: A description of a method for the treatment of mercuric chloride poisoning in which alkali hypertonic salts are given by mouth, by rectum, and intravenously.—J. Am. M. Assoc. 1917, v. 68, p. 1618–1620.

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HYDRARGYRI CHLORIDUM MITE.

Asher, Philip: An explanation of the chemistry of the U. S method for the assay of mercurous chloride.—Am. J. Pharm. 1 v. 89, p. 169.

Guthrie, C. P.: The HgCl content of 18 samples of calomel te varied from 95.34 per cent to 99.77 per cent. The U. S. P. req not less than 99.6 per cent.—Bull. North Dakota Exper. Sta. F. I 1917, v. 4, p. 357.

HYDRARGYRI IODIDUM RUBRUM.

Franceschi, G. B.: A note on the action of hydrogen sulp upon mercuric iodide in alcoholic mixtures. When a small am of hydrogen sulphide is employed the compound formed has formula $HgS.HgI_2$. If an excess of hydrogen sulphide is pre HgS is formed. An abstract.—Giorn. farm. chim. 1917, v. 6 104–105.

Smits, A.: An investigation of the system, mercury iodide. mercuric iodide is transformed into the yellow modification at 12 When this is heated further it remains yellow up to 190°, and assumes a red tint, which deepens, until the substance melts, dark red liquid at 255.5°.—Proc. K. Akad. Wetensch. Amsterd 1917, v. 19, p. 703–708, through J. Chem. Soc. Lond. 1917, v. part 2, p. 174.

Tammann, G.: A colorless modification of mercuric iodide is tained if mercuric iodide is heated at about 300 to 500° C. in a glass tube, one end of which is connected to a receiver, in which pressure can suddenly be decreased from 1 to one-tenth atmosph The iodide condenses in the form of a colorless snow, which beco pink in a few seconds and red after some minutes.—Chem. Zentr 1917, v. 1, p. 1065, through J. Chem. Soc. Lond. 1917, v. 112, 2, p. 474.

HYDRARGYRI OXIDUM FLAVUM.

Asher, Philip: An explanation of the chemistry of the U. S. IX, method for the assay of mercuric oxide.—Am. J. Pharm. 191 89, p. 171.

HYDRARGYRI SALICYLAS.

Asher, Philip: An explanation of the chemistry of the U. S. IX, method for the assay of mercury salicylate.—Am. J. Ph 1917, v. 89, p. 169.

Laj[illegible] H.: The quantitative determination of mercury in ba[illegible] of mercury and its isomers. The mercury is ei

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weighed as the sulphide or determined according to the cyanometric method of Denigès.—J. pharm. et chim. 1917, v. 15, p. 241–246; Ann. chim. analyt. 1917, v. 22, p. 114.

Lascoff, J. Leon: A discussion of the modes of compounding or preparing prescriptions containing mercuric salicylates.—J. Am. Pharm. Assoc. 1917, v. 6, p. 143–145.

HYDRARGYRUM.

Anon.: The production of mercury in California during 1916 amounted to 21,400 flasks of 75 pounds each.—Chem. & Drug. 1917, v. 89, p. 662.

Anon.: Data relative to the production of mercury in Spain for the years 1911 to 1915 are given. In 1915 the production amounted to 20,717 tons.—Chem. & Drug. 1917, v. 89, p. 765.

Patten, Harrison E., and Mains, Gerald H.: An illustrated description of an apparatus for the purification of mercury.—J. Ind. & Eng. Chem. 1917, v. 9, p. 600–603.

Dunnicliffe, Horace B.: An illustrated description of the arrangement of apparatus for the purification of mercury intended for the filling of barometers.—Chem. News, 1917, v. 116, p. 41–42.

Wilhelm, R. M.: Data relative to the freezing point of mercury are presented and discussed. Samples of mercury purified according to three different methods were used in the experiments. One of the samples was purified to meet the requirements of the U. S. P.—Bur. Standards Sci. Paper, 1916, No. 204, p. 655–661.

Skanpy, Franz: An experimental study to determine the specific heat of liquid mercury.—Ber. deutsch. physik. Ges. 1916, v. 18, p. 302–307, through Chem. Abstr. 1917, v. 11, p. 2851.

Egerton, A. C.: Data are presented relative to the vapor pressure of mercury determined by a method based on that of Knudsen.—Phil. Mag. 1917, v. 33, p. 33–48.

Wastenson, Hugo: A method for determining mercury in pharmaceutical preparations is described. This method is stated to give excellent results as compared with the methods prescribed in the Ph. Svec. and Ph. Germ.—Svensk farm. Tidskr. 1917, v. 21, p. 54–59; Pharm. Post, 1917, v. 50, p. 125–126; J. Chem. Soc. Lond. 1917, v. 112, part 2, p. 509.

Rupp, E., and Herrmann, A.: A report of investigations to determine the constitution and properties of sozoiodo-mercury compounds.—Arch. Pharm. 1916, v. 254, p. 488–497, through J. Chem. Soc. Lond. 1917, v. 112, part 1, p. 516.

Herrmann, A.: A description of a simple method for estimating the mercury in sozoiodol-mercury preparations is given.—Arch. Pharm. 1916, v. 254, p. 498–500, through J. Chem. Soc. Lond. 1917, v. 112, part 2, p. 399.

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Lemholt, Svend, and Christiansen, J. A.: A method for the mation of small amounts of mercury in organic substances i scribed in detail.—Biochem. Ztschr. 1917, v. 81, p. 356–379, thı J. Chem. Soc. Lond. 1917, v. 112, part 2, p. 424.

Marsh, J. E., and Lye, O. G.: A description of a method fo quantitative estimation of mercury in organic compounds. process described is a modification of the method of estimating cury by combustion with lime.—Analyst, 1917, v. 42, p. 84.

Spica, C. L.: For the purpose of obtaining information relati the detection of mercury in toxicological cases, a series of experii were conducted to determine whether mercuric chloride and ca undergo material change when kept in contact with visceral ma preserved with alcohol.—Gazz. chim. ital. 1917, v. 47, p. 139 Boll. chim.-farm. 1917, v. 56, p. 437–440.

Elliott, J. A.: Experimental details for the detection of quantities of mercury in tissues and body fluids by a mo Reinsch method are described.—J. Am. M. Assoc. 1917, v. (1693–1694.

Browning, K. C.: A description of an electrolytic method fc toxicological detection of traces of mercury.—J. Chem. Soc. 1917, v. 111, p. 236.

Engelhardt, H.: Several lots of mercury were rejected be they contained a large portion of amalgams of other metals.—J Pharm. Assoc. 1917, v. 6, p. 411.

Dohme, A. R. L.: Several lots of mercury containing ama were examined and rejected.—Proc. N. W. D. A. 1917, p. 506.

Wile, Udo J., and Elliott, Joseph A.: An investigation of the of action of mercury when administered by inunction.—J. Pharm. Assoc. 1917, v. 68, p. 1024.

François, Maurice: Notes on the preparation of mercuric la and on the stability of the same in aqueous solutions.—J. phar chim. 1917, v. 15, p. 23–41; Farm. Españ. 1917, v. 49, p. 102 119–120.

Schamberg, J. F., et al.: A study of various organo-mercury pounds to determine their value as chemotherapeutic agents.- J. Syphilis, 1917, v. 1, p. 1.

Pégurier, G.: Notes on precautions to be observed in the pre tion of gray oil for injection. A modified military formula for m this preparation is also described.—Répert. pharm. 1917, v. 97–102.

HYDRARGYRUM CUM CRETA.

Dohme, A. R. L.: The committee on standards and deterio of the American Drug Manufacturers' Association suggests 33 cent Hg in mercury with chalk instead of 38 per cent, as it is th that the percentage of mercury is too high, it being difficult to r . Am. Drug. Mfg. Assoc. 1917, p. 184.

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HYDRASTIS.

Dohme, A. R. L.: Golden seal has frequently been substituted by twin leaf root. In a few cases xanthorrhiza was offered as golden seal.—Proc. N. W. D. A. 1917, p. 520.

Anon.: A note on the cultivation of hydrastis in Austria states that the experiments in acclimatization have been successful and that the alkaloidal content of the drug obtained is even greater than that grown in America.—Pharm. J. Lond. 1917, v. 99, p. 29.

Anon.: The hydrastine content of nine samples of hydrastis assayed was above standard.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 92.

Congdon, Leon A.: Of 23 samples of hydrastis examined between 1905 and 1917 only four were legal or came strictly up to the requirements, making a percentage of 17.39 per cent legal and 82.61 per cent illegal.—Proc. Kansas Pharm. Assoc. 1917, p. 87.

Dohme, A. R. L.: Four samples of hydrastis examined assayed 5.5 per cent, 3.2 per cent, 2.68 per cent, and 2.53 per cent of ether-soluble alkaloid.—Proc. N. W. D. A. 1917, p. 509.

Roberts, J. G.: The only lot of hydrastis examined contained 2.65 per cent of ether-soluble alkaloids.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 85.

Sayre et al.: The alkaloidal content of five samples of powdered hydrastis assayed was 2.42, 2.48, 2.55, 2.56, and 2.99 per cent, respectively.—Rep. Kansas Bd. Health, 1917, v. 13, p. 172 and 263.

Scoville, W. L.: Five samples of hydrastis examined showed a hydrastine content ranging from 2.23 to 3.7 per cent. One sample assayed 5.5 per cent.—J. Am. Pharm. Assoc. 1917, v. 6, p. 410.

HYOSCYAMUS.

Roberts, J. G.: A mixture of foreign leaves, pods, and large stems was offered as henbane.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 86.

Sayre et al.: One sample of powdered hyoscyamus examined was adulterated with *Hyoscyamas muticus*.—Rep. Kansas Bd. Health, 1917, v. 13, p. 264.

Alsberg, C. L.: It is the opinion of the Bureau of Chemistry that *Hyoscyamus muticus* can not be used in any of the preparations official in the U. S. P., as it differs from *Hyoscyamus niger*, in that it contains a liquid base not present in the former and does not contain scopolamine.—S. R. A.-Chem. 1917, No. 19, p. 51.

Anon.: A sample of *Hyoscyamus muticus* examined in the H. K. Mulford laboratories was found to contain 0.7 per cent of alkaloids. Physiological tests, however, demonstrated that the alkaloids extracted from this drug had practically no mydriatic effect.—Drug. Circ. 1917, v. 61, No. 3, p. 25.

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Anon.: A sample of *Hyoscyamus muticus* consisting of stems, leaves, and calyces was found to contain 10.94 per cent of moisture and 0.61 per cent of total alkaloids.—Bull. Imp. Inst. 1917, v. 15, p. 325–326.

Dohme, A. R. L.: One sample of hyoscyamus root which was examined assayed 0.44 per cent of mydriatic alkaloids. It was very likely the root of *Hyoscyamus muticus*.—Proc. N. W. D. A. 1917, p. 509.

E'we, G. E.: One lot of *Hyoscyamus muticus* examined assayed 0.728 per cent of alkaloids, which, however, appeared not to be true mydriatic solanaceous alkaloids.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 85.

Anon.: Of seven samples of henbane assayed, the alkaloidal content of six was above standard and one below.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 92.

Dohme, A. R. L.: Two out of nine shipments of henbane were rejected because of their low alkaloidal content.—Proc. N. W. D. A. 1917, p. 508.

Engelhardt, H.: Of 24 samples of hyoscyamus examined, 15 were rejected for being low in alkaloidal content. The other 5 assayed from 0.08 to 0.12 per cent of alkaloids.—J. Am. Pharm. Assoc. 1917, v. 6, p. 410.

Patch, E. L.: The alkaloidal content of nine samples of hyoscyamus examined ranged from 0.017 to 0.0867 per cent. Eight of the samples were below the U. S. P. standard.—J. Am. Pharm. Assoc. 1917, v. 6, p. 410.

HYPOPHYSIS SICCA.

Guggenheim, M.: A reply to Führer's criticism of the author's work on the active principle of the pituitary gland.—Biochem. Ztschr. 1917, v. 81, p. 274–277, through J. Chem. Soc. Lond. 1917, v. 112, part 1, p. 526.

Hamilton, Herbert C.: The U. S. P. test for pituitary body is criticized because of the following features: (1) The inaccurate and unsatisfactory character of the method. (2) The standard, which is not adapted to measuring blood-pressure activity, is not a practical oxytocic agent in therapeutics and is not derived from the pituitary gland. (3) The activity of the standard product.—Am. J. Pharm. 1917, v. 89, p. 61–71.

Adams, H. S.: Notes on the use of the pituitary body in therapeutics.—Am. J. Pharm. 1917, v. 89, p. 135–137.

Robertson, T. B.: U. S. patent No. 1218472. A method for the manufacture of medicinal preparations from pituitary glands.—Chem. Abstr. 1917, v. 11, p. 1521.

For further references on the standardization of pituitary preparations see under "Liquor Hypophysis."

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ICHTHYOL (NONOFFICIAL).

Anon.: Notes on the derivation of the name "ichthyol" and on the history of ichthyol. An abstract.—Chem. & Drug. 1917, v. 89, p. 210.

Scheibler, H.: Notes on the chemical constituents of sulphur-containing bituminous oils, ichthyol oils.—Ber. deutsch. chem. Gesellsch. 1916, v. 49, p. 2595–2600, through J. Soc. Chem. Ind. 1917, v. 36, p. 285.

Dohme, A. R. L.: Substitutes for ichthyol are being offered, most of which are satisfactory.—Proc. N. W. D. A. 1917, p. 509.

Méran, L.: A note on "saurol," a substitute for ichthyol, obtained by distilling a bituminous shale found in a mine near Lake Lugano, Switzerland.—Pharm. J. 1917, v. 98, p. 43.

IGNATIA, N. F.

Roberts, J. G.: In three lots of ignatia examined, 2.72, 2.73, and 3.05 per cent of alkaloids were found.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 86.

INFUSUM DIGITALIS.

Beringer, George M.: The advisability of the omission of alcohol in the preparation of the infusion of digitalis as directed in the U. S. P. IX, is questioned. The new formula is said to yield a preparation which is less stable than that of the U. S. P. VIII.—Am. J. Pharm. 1917, v. 89, p. 351.

Lascoff, J. Leon: A physician when prescribing the infusion of digitalis expects that a freshly prepared infusion will be dispensed. The omission of alcohol in the U. S. P. IX, formula for this preparation is therefore commendable, as it will discourage the pharmacist from keeping the same on hand.—Am. Druggist, 1917, v. 65, No. 5, p. 25.

Toplis, William G.: A description of a method for preparing a permanent infusion of digitalis.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 186.

INFUSUM SENNÆ COMPOSITUM.

Broeksmit, T. C. N.: Notes on the preparation of compound infusion of senna and on the determination of its calcium and magnesium content.—Pharm. Weekbl. 1917, v. 54, p. 1369–1371.

INUNCTA.

Beringer, George M.: The title "inunctum" has been introduced by the N. F., IV, for hydrous wool-fat ointments which are intended to be rubbed in.—Proc. New Jersey Pharm. Assoc. 1917, p. 92.

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IODOFORMUM.

Chiaria: Data are presented showing the solubility of iodoform in glycerin. At 15° C. it is stated to be soluble to the extent of 0.123 per cent.—Giorn. farm. chim. 1917, v. 66, p. 94–96.

Massol and Faucon: A report of a study dealing with the absorption of ultra-violet rays by iodine derivatives of methane in alcoholic solution.—Bull. soc. chim. France, 1917, v. 21, p. 207–211.

Heiner, W.: A solution of 10 parts of iodoform in 100 parts of acetone to which 3 drops of ammonia water have been added is stated to be an excellent styptic and antiseptic.—Pharm. Weekblad, 1917, v. 54, p. 164.

Thompson and Snyder: A method for assaying iodoform gauze, which does not require distillation, is described in detail.—J. Am. Pharm. Assoc. 1917, v. 6, p. 18.

IODUM.

Winkler, L. W.: Data relative to the iodine content of sea water are presented.—Ztschr. angew. Chem. 1916, v. 29, p. 205, through Pharm. Weekblad, 1917, v. 54, p. 217.

Weibull, M.: A note on the iodine content of seaweeds growing along the coasts of Sweden.—Apoth. Ztg. 1917, p. 168, through Pharm. Weekblad, 1917, v. 54, p. 1426–1427.

Okuda, T., and Eto, T.: A report of investigations to determine the form of iodine in marine algæ.—J. Coll. Agric. Tokyo, 1916, v. 5, p. 341, through J. Soc. Chem. Ind. 1917, v. 36, p. 502.

DeJong, M.: The recovery of iodine from the urine of patients receiving iodine is recommended as a commercial venture for hospitals.—Pharm. Weekblad, 1917, v. 54, p. 77–79.

Guichard, Marcel: A description of a method for determining the atomic weight of iodine by the analysis of iodic acid anhydride. The atomic weight found by this method is given as 126.915.—Bull. soc. chim. France, 1917, v. 23, p. 56–63.

Hildebrand, Joel H. et al.: Data relative to the solubilities of anthracine, anthraquinone, parabromobenzene, phenanthrene, and iodine in various solvents are presented.—J. Am. Chem. Soc. 1917, v. 39, p. 2301–2302.

Thompson and Snyder: Methods for the assay of various iodine compounds and iodine preparations used in pharmacy are described. Methods are given for tincture of iodine, iodoform gauze, iodized oils, and iodine ointment.—J. Am. Pharm. Assoc. 1917, v. 6, p. 18–20.

Kempf, Richard: Notes on the titration of iodine with thiosulphate. Attention is directed to the importance of avoiding the use of an excess of mineral acids in iodine solutions which are titrated with thiosulphate solution.—Ztschr. angew. Chem. 1917, v. 30, part 1, [illegible] 72, through J. Chem. Soc. Lond. 1917, v. 112, part 2, p. 502.

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van Os, D.: Researches on the quantitative determination of iodine in mineral waters and in thyroid gland.—Pharm. Weekblad, 1917, v. 54, p. 350–353.

Bougault, J.: A study of the action of iodine on the alkalies.—Compt. rend. acad. sc. 1917, v. 164, p. 949–951.

Borrutan, H.: A report of researches to determine the therapeutic activity of iodine.—Physiol. Abstr. 1917, v. 2, p. 360.

Sollmann, T.: A report of investigations to determine the fate of iodine, iodides, and iodates in the body.—J. Pharmacol. 1917, v. 9, p. 269–278.

Baradulin, G. I.: A report on the employment of iodine vapor in the treatment of tuberculosis of the bladder.—Russky Vrach, 1917, v. 16, p. 60, through J. Am. M. Assoc. 1917, v. 68, p. 1671.

Cozin, M. H.: A note calls attention to the harmful effects produced by the use of iodine in the treatment of pyorrhea.—Pharm. J. Lond. 1917, v. 98, p. 365.

IPECACUANHA.

Farwell, Oliver Atkins: The proper combinations to designate the ipecacs are *Ouragoga Ipecacuanha* (Brotero) Farwell and *Ouragoga Acuminata* Karsten Farwell.—Drug. Circ. 1917, v. 61, p. 175.

Alsberg, C. L.: Examination of samples of importations of "ipecac" by the Bureau of Chemistry has shown that *Heteropteris pauciflora*, *Ipecacuanha fibrosa*, and *Ionidium* species have been substituted for *Cephaelis ipecacuanha*.—S. R. A.—Chem. 1917, No. 19, p. 52.

Karrer, P.: Researches on the constitution of the alkaloids of ipecac. The author finds that "dehydroemetine" is identical with the "rubremetine" of Carr and Pyman. The preparation and properties of an isomeride of emetine are also described.—Ber. deutsch. chem. Gesellsch. 1917, v. 50, p. 582–586, through J. Chem. Soc. Lond. 1917, v. 112, part 1, p. 378 and 409.

Keller, Oskar: Researches dealing with the alkaloids of ipecac root. A commentary on the results of the author in comparison with those of Hesse, Carr and Pyman, Hermanns, Karrer, and Paul and Cownley.—Arch. Pharm. 1917, v. 255, p. 75–80, through J. Chem. Soc. Lond. 1917, v. 112, part 1, p. 409.

Pyman, Frank L.: Two new alkaloids of emetine are described—namely, orthomethyl ether of psychotrine, which occurs in ipecac to the extent of 0.015 to 0.033 per cent, and emetamine, which is present in quantities amounting to about 0.002 to 0.006 per cent.—J. Chem. Soc. Lond. 1917, v. 111, p. 419–446.

Dohme, A. R. L.: Four samples of ipecac examined showed an emetine content of 1.54 to 1.66 per cent, and a cephaeline content of 0.42 to 1.09 per cent.—Proc. N. W. D. A. 1917, p. 510.

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Table showing the number of samples of ipecac which were deficient in alkaloids.

Reporters.	Number of samples.		References.
	Examined.	Low in alkaloid content.	
Anon	12	4	Proc. Pennsylvania Pharm. Assoc. 1917, p. 92.
Dohme, A. R. L.	27	17	Proc. N. W. D. A. 1917, p. 508–510.
Engelhardt, H.	14	4	J. Am. Pharm. Assoc. 1917, v. 6, p. 410.
Patch, E. L.	5	1	J. Am. Pharm. Assoc. 1917, v. 6, p. 410.
Roberts, J. G.	5	1	Proc. Pennsylvania Pharm. Assoc. 1917, p. 86.
Scoville, W. L.	16	6	J. Am. Pharm. Assoc. 1917, v. 6, p. 410.

Browne, Howard S.: A discussion of experimental researches on the pharmacology of emetoidine (kryptonine), a constituent of ipecac.—J. Am. Pharm. Assoc. 1917, v. 6, p. 1041–1045.

Walters, A. L., and Koch, E. W.: Pharmacological studies of the ipecac alkaloids and some synthetic derivatives of cephaeline.—J. Pharmacol. & Exper. Therap. 1917, v. 10, p. 73–81, 185–197, and 341–364.

Crowell, E. C.: A discussion of the treatment of intestinal amebiasis with special reference to the use of ipecac and its derivatives.—J. Am. M. Assoc. 1917, v. 69, p. 6–10.

E'we, G. E.: One lot of ipecac examined, apparently botanically authentic, contained no alkaloids.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 86.

IRIS, N. F.

Parry, E. J.: Data showing the variations in some of the physical and chemical constants of concrete oil of orris obtained from different sources.—Perf. & Ess. Oil Rec. 1917, v. 8, p. 275.

JALAPA.

Farwell, Oliver Atkins: The proper botanical designation for Jalap is *Exogonium Jalapa* (Nuttall and Coxe) Baillon.—Drug. Circ. 1917, v. 61, p. 232.

Rusby, H. H.: Since its recognition by the Ph. Brit. as a legitimate source of scammony resin, *Ipomœa orizabensis* has appeared on the market as powdered jalap or as a mixture of the same with powdered jalap.—J. Am. Pharm. Assoc. 1917, v. 6, p. 411.

Scoville, Wilbur L.: The Brazilian jalap, the tuber of *Pepsostagia pisonis*, contains twice to three times as much resin as the official jalap, and the resins are stated to be nearly identical chemically. The Pharmacopœia should recognize the better of these two species, and therefore knowledge of the status of the Brazilian drug should be obtained before the next revision.—Am. Druggist, 1917, v. 65, No. 1, p. 26.

The total resin content of one sample of jalap assayed was
lard.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 92.

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Dohme, A. R. L.: Four samples of jalap examined yielded 5.55 per cent, 5.8 per cent, 7.16 per cent, and 7.75 per cent resin, respectively.—Proc. N. W. D. A. 1917, p. 510.

Patch, E. L.: Seven samples of jalap examined yielded from 5.09 to 9.7 per cent of total resin and three of the samples yielded from 3.4 to 5.2 per cent of ash. Five of the samples were below the U. S. P. standard.—J. Am. Pharm. Assoc. 1917, v. 6, p. 411.

Scoville, W. L.: Of 10 samples of jalap examined during the latte part of 1915, five contained less than 6 per cent of resin, three between 6 and 7 per cent, one 7.29 per cent, and one 10.21 per cent. In 1916 the lowest resin content noted was 8.5 per cent, the highest 11.05 per cent.—J. Am. Pharm. Assoc. 1917, v. 6, p. 411.

KAOLINUM, N. F.

Sproat, I. E.: An account of the refining and utilization of Georgia kaolins.—Bull. Bur. Mines, 1916, No. 128, p. 1–59.

Rohland, P.: Researches on the adsorption of dyes by kaolin and talc.—Chem. Abstr. 1917, v. 11, p. 1723.

Rapp: A study of the properties of bolus alba for the purpose of fixing standards of purity.—Pharm. Ztg. 1916, v. 61, p. 355–356 through Chem. Abstr. 1917, v. 11, p. 1720.

Herzog, J., and Leonhard, M.: Notes on chemical tests for the purity of bolus alba.—Apoth.-Ztg. 1916, p. 532 through Pharm. Weekblad, 1917, v. 54, p. 1258.

Richert, Theodore G.: A method for the evaluation of fullers' earth for the oil industry.—J. Ind. & Eng. Chem. 1917, v. 9, p. 599–600.

KAVA, N. F.

Farwell, Oliver Atkins: The species of kava kava of the N. F., IV, is *Piper esculentum* (Raf.) Farwell.—Drug. Circ. 1917, v. 61, p. 230.

KOLA, N. F.

Farwell, Oliver Atkins: *Cola* is not tenable for this genus, there being several older names, the oldest being *Bichea Stokes*. The most important species yielding kola is *Bichea acuminata* (Beauv.) Farwell.—Drug. Circ. 1917, v. 61, p. 231.

Anon.: The alkaloidal content of 11 samples of kola assayed was above standard.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 92.

Dohme, A. R. L.: One out of four lots of kola nut examined was of inferior quality.—Proc. N. W. D. A. 1917, p. 508.

Engelhardt, H.: Of eight samples of kola examined, three assayed below 1.5 per cent of caffeine.—J. Am. Pharm. Assoc. 1917, v. 6, p. 411.

Roberts, J. G.: All lots of kola nut examined were of U. S. P. quality and contained 1.44 to 2.04 per cent of caffeine.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 87.

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Scoville, W. L.: Two samples of kola examined assayed 1.79 and 1.94 per cent of caffeine, respectively.—J. Am. Pharm. Assoc. 1917, v. 6, p. 411.

KRAMERIA, N. F.

Farwell, Oliver Atkins: *Krameria Ixina* Linné should be *Krameria Ixine* Linné. "Exina" has been in general use, but the older spelling should be restored.—Drug. Circ. 1917, v. 61, p. 230.

LAC FERMENTATUM, N. F.

Sanna, A.: A description of fermented milk products—"Laben Raieb" of Egypt and "Miciuratu" of Sardinia. An abstract.—Staz. sper. agric. ital. 1916, v. 49, p. 73–78, through Analyst, 1917, v. 42, p. 15.

LAC VACCINUM, N. F.

Arup, Paul S., et al.: Analytical data showing the composition of morning and evening milk.—Analyst, 1917, v. 42, p. 118–124.

Bosworth, A. W. and Bowditch, H. I.: Analytical data showing the identity and quantity of mineral constituents in milk.—Boston M. & S. J. 1917, v. 177, p. 248–251.

Bosworth, A. W., and Bowditch, H. I.: Experimental data showing the chemical changes produced by the addition of limewater to milk.—J. Biol. Chem. 1917, v. 28, p. 431–435.

Crowther, Charles, and Hynd, Alexander: Analytical data showing the distribution of the fatty acids in the milk fat of the cow and sheep.—Biochem. J. 1917, v. 11, p. 139–163.

Eckels, C. H., and Palmer, L. S.: An experimental study of the influence of the age of the cow on the composition and properties of milk and milk fat.—J. Agric. Res. 1917, v. 11, p. 645–658.

Quagliariello, G.: Observations on the effect of low temperatures on some physical and chemical properties of milk.—Physiol. Abstr. 1917, v. 2, p. 49.

Lee, Richard E., and Mellon, Melvin G.: A study of certain enzymes (reductases) with a view to developing a method for the differentiation of pasteurized milk from raw milk.—J. Ind. & Eng. Chem. 1917, v. 9, p. 360–366.

Brew, J. D., and Dotterrer: From experiments it is concluded that the results obtained by the microscopic method of counting bacteria in milk show that the plate counts are not counts of individual bacteria, but of groups of bacteria.—Bull. New York Agric. Exper. Sta. 1917, No. 439, p. 477–522.

McInerney, T. J.: A study of the effect of clarification on the bacterial count of milk.—Bull. Cornell Univ. Agric. Exper. Sta. 1917, No. 389, p. 487–504.

Hunziker, O. F.: Report of the chairman of the Official Dairy [illegible] Associations Committee on Official Methods of Testing

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Milk and Cream for Butter Fat.—J. Dairy Sci. 1917, v. 1, p. 38–44, through Chem. Abstr. 1917, v. 11, p. 2511.

Roy, A.: Fat determinations are not sufficient for establishing normal milk. The specific gravity of the milk serum should also be determined.—Svensk. farm. Tidskr. 1917, v. 21, p. 337–341.

Barthel, Chr.: From experiments it is concluded that the reductase test combined with the fermentation test is the best practical test for milk.—Ztschr. Unters. Nahr. u. Genussm. 1917, v. 34, p. 137.

Stutterheim, G. A.: Methyl red is recommended as an indicator in the determination of the acidity of milk.—Pharm. Weekblad, 1917, v. 54, p. 1120–1121.

Wilhelm, G.: Some notes on the examination of milk. Special note is made of the refractometer value of the serum of cow's milk, the density, the whey content, and the acidity.—Ztschr. Unters. Nahr. u. Genussm. 1916, v. 32, p. 573–576, through Analyst, 1917, v. 42, p. 328.

Pritzker, J.: An enumeration of conditions which caused a variation in the freezing point in milk. The freezing point of milk varies correspondingly with the refractometer number.—Ztschr. Unters. Nahr. u. Genussm. 1917, v. 34, p. 69–112, through Physiol. Abstr. 1917, v. 2, p. 619.

Polak, J. J.: From experiments it is concluded that the freezing point method affords the most trustworthy test for the presence of water in milk.—Chem. Weekblad, 1917, v. 14, p. 323–324.

Stutterheim, G. A.: Data on the freezing point of cow's milk are presented.—Pharm. Weekblad, 1917, v. 54, p. 458–459.

Müller-Hössly, E.: A discussion of a formula for the calculation of added water in adulterated milk and of the relations between the specific gravity and refractive index of the calcium chloride serum.—Mitt. Lebensm. Hyg. 1917, v. 9, p. 47–54, through Chem. Abstr. 1918, v. 12, p. 1568.

Ferris, L. W.: A note on the detection of added water in milk by means of a simplified molecular concentration constant.—J. Ind. & Eng. Chem. 1917, v. 9, p. 957–959.

Durand, Halsey: Notes on the detection of added water in milk.—J. Ind. & Eng. Chem. 1917, v. 9, p. 44–45.

Keister, J. T.: A report on the application of the cryoscopic method for the determination of added water in milk.—J. Ind. & Eng. Chem. 1917, v. 9, p. 862–865.

Anon.: A test for the detection of sucrose in milk makes use of the following reagent: Ammonium molybdate, 20 grams; hydrochloric acid, 100 grams; and water to make 1,000 cubic centimeters. The presence of sucrose is indicated by the development of an intensely blue color.—Pharm. Weekblad, 1917, v. 45, p. 1360; see also Répert. pharm. 1917, v. 28, p. 2, 82.

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Hamner, B. W., and Bailey, D. E.: A rapid volumetric method for the approximate estimation of chlorine in milk is described.—Bull. Iowa Agric. Exper. Sta. 1917, No. 41, p. 337–348.

Yakeno, Y.: From experiments it is concluded that Siegfried's nucleone is not a definite chemical compound, as its nitrogen and phosphorus content are not constant but vary.—Chem. Abstr. 1917, v. 11, p. 2350.

Anon.: An editorial discussing the antineuritic properties of milk.—J. Am. M. Assoc. 1917, v. 69, p. 40–41.

LAPPA, N. F.

Dohme, A. R. L.: A number of shipments of burdock root examined were heavily adulterated with two-year-old roots.—Proc. N. W. D. A. 1917, p. 519.

LEPTANDRA, N. F.

Farwell, Oliver Atkins: The proper nomenclature, according to rules of priority, for the plants producing this drug is *Veronicastrum Virginicum* (Linné) Farwell and *Veronicastrum Virginicum* (Lin.) Farwell var. *Lanceolatum* Farwell.—Drug. Circ. 1917, v. 61, p. 231.

LIMONIS CORTEX.

Farwell, Oliver Atkins: The botanical source of the lemon is *Citrus Medica* Lin. var. *Limon* Lin. This is the oldest name and should be adopted in preference to the later one of Hooker filius; and *Citrus Limonia* Osbeck, if as a distinct species.—Drug. Circ. 1917, v. 61, p. 175.

LINIMENTUM AMMONIÆ.

Beringer, George M.: In the U. S. P., VIII, formula for the preparation of ammonia liniment, it was necessary to use oleic acid in order to saponify the cottonseed oil. In the new formula a perfect preparation is obtained by agitating one volume of ammonia water with three volumes of sesame oil.—Am. J. Pharm. 1917, v. 89, p. 352.

Lascoff, J. Leon: The U. S. P., IX, formula for the preparation of ammonia liniment is far superior to that of the U. S. P., VIII. The preparation does not separate and it keeps better.—Am. Druggist, 1917, v. 65, No. 5, p. 25.

Hommell, P. E.: Lard oil should be used in the preparation of ammonia liniment instead of sesame oil, as a better saponification would result.—Proc. New Jersey Pharm. Assoc. 1917, p. 83.

Tice, William G.: Of 31 samples of ammonia liniment examined, 16 were below standard.—Rep. New Jersey Dept. Health, 1917, p. 62.

LINIMENTUM BELLADONNÆ.

Asher, Philip: A process for the assay of belladonna liniment should be introduced into the U. S. P.—Am. J. Pharm. 1917, v. 89,

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LINIMENTUM CAMPHORÆ.

Hommell, P. E.: Oil of sesame should replace the cottonseed oil in camphor liniment, as it is more emollient and more demulcent and better absorbed by the dermal surface. Cottonseed oil is sometimes deficient in these properties, especially the impure kind, which is resinous and drying.—Proc. New Jersey Pharm. Assoc. 1917, p. 83.

Diekman, George C.: Experienced laboratory men are by no means agreed that the degree of accuracy in the results obtained by the U. S. P. method for the assay of camphorated oil is such as to have justified the introduction of this method to the exclusion of all other methods, some of them much simpler of execution and yielding results sufficiently accurate for all practical purposes.—Proc. New York Pharm. Assoc. 1917, p. 97.

Bordier, H., and Roy, G.: From experiments it is concluded that when camphorated oil is agitated with water, a colloidal solution is formed. The biological and therapeutic significance of this property is discussed.—Compt. rend. acad. sc. 1917, v. 164, p. 648–650.

Kebler, L. F., and others: Of 42 samples of camphor liniment examined, 17, or 40 per cent, came within a 10 per cent limit; 24, or 57 per cent, came within a 15 per cent limit; 28, or 67 per cent, came within a 20 per cent variation from the U. S. P. standard.—J. Am. Pharm. Assoc. 1917, v. 6, p. 617–618.

Table showing some of the analytical results reported for camphor liniment.

Reporters.	Number of samples.		References.
	Examined.	Rejected.	
Anon.....	11	3	Bull. Vermont Bd. Health, 1917, v. 17, Nos. 3 and 4.
Casey, F. W....	13	7	Bull. Michigan D. & F. Dept. 1917, No. 256–257, p. 16.
Frary, Guy G..	6	1	Rep. South Dakota F. & D. Com. 1917, p. 97.
Lea, E. J.....	36	18	Rep. California Bd. Health, 1917, p. 162.
Todd, A. E.....	13	4	Bull. Michigan D. & F. Dept. 1917, No. 264–267, p. 24.

LINIMENTUM CHLOROFORMI.

Asher, Philip: A process for the assay of chloroform liniment should be included in the U. S. P.—Am. J. Pharm. 1917, v. 89, p. 175.

Pozen, M. A.: Of 42 samples of chloroform liniment examined, 29 were rejected for being below standard.—Rep. District of Columbia Health Off. 1917, p. 50.

LINIMENTUM SAPONATO-CAMPHORATUM, N. F.

Lybing: An investigation of the color changes in opodeldoc. The greenish color change observed is not due to traces of copper, but to thymol. If thymol is replaced by oil of thmye, no color change will be observed after several months.—Svensk farm. Tidskr. 1917, v. 21, p. 135.

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Fassati, C.: A war formula for the preparation of opodeldoc is presented.—Pharm. Post, 1917, v. 50, p. 197.

LINIMENTUM SAPONIS.

Hommell, P. E.: Soap liniment is no doubt an ideal vehicle for ammonia, turpentine, capsicum, etc., but not for the successful employment of chloroform, ether, oil of wintergreen, or menthol. Good olive oil is the best vehicle for these substances.—Proc. New Jersey Pharm. Assoc. 1917, p. 83.

Kebler, L. F., and others: Of 77 samples of soap liniment examined, 56, or 73 per cent, came within a 20 per cent variation from the official standard.—J. Am. Pharm. Assoc. 1917, v. 6, p. 684.

LINIMENTUM TEREBINTHINAE.

Hommell, P. E.: Turpentine liniment should be in the N. F. or deleted entirely, as it is seldom prescribed. Decades ago it was occasionally exhibited for scalds, frostbites, and other skin lesions, but to-day it is a dead one with the modern therapeutics.—Proc. New Jersey Pharm. Assoc. 1917, p. 83.

LINIMENTUM TEREBINTHINAE ACETICUM, N. F.

Hommell, P. E.: Stoke's liniment was originated for the purpose of obtaining the irritant and counterirritant action of turpentine. A combination of turpentine with camphorated oil answers the same purpose. The oil of lemon and rose water in it does not successfully conceal the strong odor of turpentine, as all dispensers know. The N. F. would be better off without this preparation, as it is but rarely prescribed.—Proc. New Jersey Pharm. Assoc. 1917, p. 83.

LINUM.

Kunz-Krause, H., and Brandes, C.: The description of flaxseed in the fifth edition of the Ph. Germ. excludes the admixture of the yellow seed, as distinguished from the third and fourth editions. The authors find on investigation that such exclusion is unwarranted, not only with respect to size, weight, and oil content of the grain, but also as regards the power of germination.—Arch. Pharm. 1916, 254, p. 33–44 through Chem. Abstr. 1917, v. 11, p. 2388.

LIQUORES.

Anon.: General formulas for the preparation of isotonic solutions are presented and discussed. An abstract.—Giorn. farm. chim. 1917, v. 66, p. 129–132.

Bradley, Theodore J.: A discussion of the preparation of percentage solutions of quinine bisulphate and silver nitrate.—J. Am. Pharm. Assoc. 1917, v. 6, p. 955–956.

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Broeksmit, T. C. N.: A method for preparing Liquor Ferri mitior et Calcis is described.—Pharm. Weekbl. 1917, v. 54, p. 1399.

Palme, Herman: A detailed study of the products formed in the preparation of Liquor Ferri Caseinati: "The chief components are colloidal $Fe(OH)_3$ and split products of casein, together with some sugar, glycerol, and alcohol."—Arch. Pharm. Chem. Copenhagen, 1917, v. 24, p. 137–141, 155–160, 166–168.

Stewart, Douglas H.: Notes on the preparation and use of the solution of magnesium hypochlorite.—New York M. J. 1917, v. 105, p. 648–649.

Duret, F.: A method for the preparation of magnesium hypochlorite solution. This solution is stated to be much more stable than Labarraque's or Dakin's solution. An abstract.—J. pharm. et chim. 1917, v. 15, p. 287.

Jacquot: A description of methods for the preparation of aqueous solutions of benzoate of mercury and of oleaginous solutions of calomel.—Farm. Españ. 1917, v. 49, p. 599–600.

Romanelli, Romolo: A note on the use of camphor for the preservation of solutions which are prone to be attacked by microorganisms.—Giorn. farm. chim. 1917, v. 66, p. 126–128.

LIQUOR ALUMINI ACETATIS, N. F.

Schoorl, N.: Investigation showed that the Liquor Alumini Acetatis of the Ph. Nedl. is a saturated solution of lead sulphate in basic aluminum acetate. It is therefore not permissible to dispense a dilute solution of basic aluminum acetate for this preparation, as has become the practice in Holland.—Pharm. Weekblad, 1917, v. 54, p. 892–898.

LIQUOR ALUMINI SUBACETATIS, N. F.

Mayer, Joseph L.: In commenting on a standard for the solution of aluminum subacetate it is stated that the N. F., IV, standard, if based upon the method of assay weighing as Al_2O_3, is too low. In place of "each gram of solution of aluminum subacetate corresponding to not less than 0.02363 gm. nor more than 0.02521 gm. of aluminum oxide (Al_2O_3)," the solution yields practically 0.0300 gm., or 2.882 per cent.—Pharm. Era, 1917, v. 50, p. 212.

LIQUOR ARSENI ET HYDRARGYRI IODIDI.

Asher, Philip: An explanation of the chemistry of the U. S. P., IX, method for the assay of Donovan's solution.—Am. J. Pharm. 1917, v. 89, p. 171.

Rosen, Joseph: The results obtained when assaying Donovan's solution for arsenious iodide are usually low, owing to the oxidation of the arsenious iodide. Tests carried out with the Gooch-Browning method showed the proper content of total arsenic.—J. Am. Pharm. Assoc. 1917, v. 6, p. 951.

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LIQUOR CALCIS.

Anon.: A sample of limewater examined in England was found to be deficient in lime to the extent of 20.9 per cent.—Brit. Food J. 1917, v. 19, p. 180.

Congdon, Leon A.: Of 30 samples of limewater examined between 1905 and 1917, 19 were passed and 11 were illegal or below the standard, making a percentage of 63.33 per cent legal and 36.67 per cent illegal.—Proc. Kansas Pharm. Assoc. 1917, p. 87.

Guthrie, C. P.: One of five samples of limewater assayed contained less $Ca(OH)_2$ than required by the U. S. P.—Bull. North Dakota Exper. Sta. F. Dept. 1917, v. 4, p. 352.

Kebler, L. F., and others: Of 62 samples of limewater examined, 47, or 76 per cent, came within 20 per cent of the U. S. P. standard, and 49, or 79 per cent, came within 25 per cent of the standard.—J. Am. Pharm. Assoc. 1917, v. 6, p. 618.

Sayre, L. E., et al.: All of five samples of limewater assayed were up to standard.—Rep. Kansas Bd. Health, 1916, v. 12, p. 427–428.

LIQUOR COCCI, N. F.

Muttelet, C. F.: Some analytical characteristics of the ammoniacal extract of cochineal are presented and discussed.—Ann. Falsif. 1917, v. 10, p. 228–229.

LIQUOR CRESOLIS COMPOSITUS.

Lascoff, J. Leon: The compound solution of cresol has been improved by the addition of alcohol, as directed in the U. S. P. IX. It has been further improved by the use of sodium hydroxide in place of potassium hydroxide, and the cost of the preparation has thereby been reduced.—Am. Druggist, 1917, v. 65, No. 5, p. 25.

Anon.: Notes on the preparation of the compound solution of cresol.—N. A. R. D. J. 1917, v. 25, p. 15-16.

Asher, Philip: The Pharmacopœia should prescribe a method of assay for solution of cresol compound.—Am. J. Pharm. 1917, v. 89, p. 175.

Dohme, A. R. L.: As the Bureau of Chemistry is insisting upon close agreement both in cresol and water content, an assay process for this preparation should be given in the U. S. P.—Proc. N. W. D. A. 1917, p. 503.

Davies, W. W.: In order to comply with the labeling requirements of the insecticide act of 1910, it is necessary to determine the amount of inert matter (water) contained in the solution. It is thought that the U. S. P. should, therefore, prescribe a test for this purpose.—Pract. Drug. 1917, v. 35, No. 12, p. 28.

Engelhardt, H.: A sample of solution of cresol compound was rejected because it contained 20 per cent of water. It had probably been manufactured with soft soap.—J. Am. Pharm. Assoc. 1917,

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LIQUOR FERRI ALBUMINATI, N. F.

Anon.: In commenting on the N. F. method of preparing solution of albuminate of iron, it is stated that the same is a delicate product and should be properly preserved. It should be stored in cork-stoppered, amber-colored bottles, containing not over 8 ounces, securely corked, in an even, cool temperature, and protected from acid fumes.—N. A. R. D. J. 1917, v. 24, p. 8.

LIQUOR FERRI CITRATIS, N. F.

Engelhardt, H.: Some of the samples of the solution of ferric citrate examined were in a gelatinous condition, while others did not form clear solutions.—J. Am. Pharm. Assoc. 1917, v. 6, p. 414.

LIQUOR FORMALDEHYDI.

Stutterheim, G. A.: Formaldehyde in aqueous solution can be estimated by determining the refractive index of the solution. The values of this constant for percentages from 1 to 45 at 17 to 18° C. are given. The mean increase for each per cent is 0.00111.—Pharm. Weekblad, 1917, v. 54, p. 716–717.

Woker, Gertrud: An explanation of results presented in a former paper dealing with the reaction between starch and formaldehyde and the supposed diastatic properties of formaldehyde.—J. Chem. Soc. Lond. 1917, v. 112, part 1, p. 447–448.

von Kaufmann, Wilhelm: Observations on the reaction between formaldehyde and starch, and the supposed diastatic properties of formaldehyde.—J. Chem. Soc. Lond. 1917, v. 112, part 1, p. 251.

LIQUOR HYDROGENII DIOXIDI.

Nussbaum: A description of an electrolytic method for the preparation of hydrogen dioxide.—Schweiz. Apoth.-Ztg. 1916, v. 54, p. 238–239.

Dohme, A. R. L.: The committee on standards and deterioration of the American Drug Manufacturers' Association finds it desirable to determine the keeping qualities of hydrogen peroxide and whether or not a preservative is needed.—Proc. Am. Drug Mfg. Assoc. 1917, p. 184.

Congdon, Leon A.: The solution of hydrogen peroxide may be preserved indefinitely without loss of strength if kept in an amber-colored bottle in a cool place. The bottle should be stopped with cotton to filter out dust particles.—Proc. Kansas Pharm. Assoc. 1917, p. 90.

Liebknecht, O., and Schaidhauf, A.: U. S. patent No. 1,213,921. Hydrogen peroxide solutions are stabilized by the addition of 0.1 to 0.3 per cent of a tin compound such as $Sn(OH)_4$ or Na_2SnO_3.—Chem. Abstr. 1917, v. 11, p. 1027.

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Akt. Astra Apotek. Kemiska Fabriken: Swedish patent No. 41,709 related to the addition of phenol ethers, such as guaiacol, cresol, or derivatives, to solution of hydrogen peroxide for the purpose of imparting stability.—Chem. Abstr. 1917, v. 11, p. 1273.

Anon.: Under laboratory notes of the H. K. Mulford Co. it is stated that the yellow color occasionally noted in solutions of hydrogen peroxide is due to the decomposition of acetanilid, which is used as a preservative agent.—Drug. Circ. 1917, v. 61, No. 1, p. 25.

Denigès, G.: A very sensitive test for hydrogen peroxide is based on the formation of dihydroxytartaric acid. Mix 2 cubic centimeters of 5 per cent tartaric acid solution with 2 drops of a 5 per cent ferrous ammonium sulphate solution; add 1 to 2 drops of the hydrogen peroxide solution, followed by 5 to 6 drops of sodium hydroxide solution. A violet color will develop in the presence of hydrogen peroxide.—Anal. Chim. analyt. 1917, v. 22, p. 193.

Macri, V.: Notes on some properties of hydrogen peroxide. The estimation of free acid in hydrogen dioxide solution may be effected by titration with permanganate, the end point being shown by the appearance of a brownish-yellow coloration.—Boll. chim.-farm. 1917, v. 56, p. 417–418.

Jamieson, George S.: A new method for the determination of hydrogen dioxide is described. The method is based on adding a measured volume of hydrogen dioxide solution to an alkaline solution containing an excess of standard sodium arsenite. After the reaction is completed concentrated hydrochloric acid is added, and the excess of arsenite is titrated with a standard solution of potassium iodate.—Am. J. Sci. 1917, v. 44, p. 150–152.

Frerichs, G.: Notes on the permanganate method of the Ph. Germ. for the quantitative estimation of hydrogen peroxide.—Apoth.-Ztg. 1916, v. 31, p. 620–621, through Ztschr. angew. Chem. 1917, v. 30, part 1, p. 121.

Bury, A.: A rapid method for the assay of hydrogen peroxide solutions is based on the liberation of oxygen when a solution of NaOCl is added.—J. pharm. et chim. 1917, v. 15, p. 189–193.

Flarity, James: A report of an incompatibility in a prescription containing, among other ingredients, solution of hydrogen dioxide and glycerin. The hydrogen dioxide reacts with the glycerin forming oxalic acid.—Proc. Wisconsin Pharm. Assoc. 1917, p. 113.

Zotier, V.: A continuation of work previously reported dealing with the action of hydrogen peroxide on the neutral salts of lead. The reaction is violent with the acetate, formate, chromate, and sulphide.—Bull. Soc. chim. France, 1917, v. 21, p. 241–243.

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Table showing some of the analytical results reported for the solution of hydrogen dioxide.

Reporters.	Number of samples—		References.
	Examined.	Rejected.	
McGill, A.....	37	1	Bull. Lab. & Inl. Rev. Dept. Canada, 1916, No. 306, p. 4, 5, and 6.
Patch, E. L.....	1	1	J. Am. Pharm. Assoc. 1917, v. 6, p. 410.
Roberts, J. G.....	1	1	Proc. Pennsylvania Pharm. Assoc. 1917, p. 87.
Sayre et al.....	6	4	Rep. Kansas Bd. Health, 1917, v. 13, p. 169.
Tice, William G..	1	1	Rep. New Jersey Dept. Health, 1917, p. 62.

LIQUOR HYPOPHYSIS.

Guggenheim, M.: A reply to Fühner's criticisms of the work on the active principle of the pituitary body.—Biochem. Ztschr. 1917, v. 81, p. 274–277, through Physiol. Abstr. 1917, v. 2, p. 517.

Adams, H. S.: A study of the thermal decomposition of the oxytocic principle of pituitary solutions. This constituent is rapidly destroyed at a temperature of 100° C., with a hydrogen-ion concentration of 10^{-5}.—J. Biol. Chem. 1917, v. 30, p. 235–242.

Abel, J. J., and Pincoffs, M. C.: A report of researches showing the presence of albumoses in extracts of the posterior lobe of the hypophysis cerebri. The albumoses present are stated to account fully for the chemical reactions which characterize the active principles of Fühner.—Proc. Nat. Acad. Sc. 1917, v. 3, p. 507–517.

Roth, G. B.: A report on investigations to determine the relative value of pituitary extracts made from various species of mammals. Data showing the variation in the activity of commercial preparations is also given.—Bull. Hyg. Lab. 1917, No. 109, p. 9.

Eckler, Charles R.: From the results obtained in the experimental standardization of pituitary extract the author concludes that the strength specified in the Pharmacopœia is about one-tenth that of the average commercial preparation.—Am. J. Pharm. 1917, v. 89, p. 195–202; Lilly Sci. Bull. 1917, No. 8, p. 277–284.

Hamilton, H. C., and Rowe, L. W.: A report of experimental work on the standardization of pituitary extract.—J. Lab. & Clin. Med. 1916–1917, v. 2, p. 120–129.

Houssay, B. A.: A résumé of our present knowledge concerning the active principles of pituitary extract. The blood pressure and uterus methods are recommended for the biological assay and the galactagogue action for the determination of the minimal dose.—Chem. Abstr. 1917, v. 11, p. 33–80.

Pittenger, Paul S., and Vanderkleed, C. E.: A preliminary note on the value of beta-iminazolylethylamine hydrochloride as a standard for testing pituitary extracts.—J. Am. Pharm. Assoc. 1917, v. 6, p. 131–133.

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Pittenger, Paul S.: Comments on the U. S. P. method for the assay of solution of the pituitary body with special reference to the standard adopted.—J. Am. Pharm. Assoc. 1917, v. 6, p. 871–872.

Snyder, J. P.: Histimine is evidently not as satisfactory a standard for pituitary extract as a solution made from the dried defatted gland, since histimine does not possess the well-known physiological property of raising the blood pressure.—J. Am. Pharm. Assoc. 1917, v. 6, p. 714.

Houssay, B. A.: A report of researches to determine the action of the pituitary extracts and their active principles on respiration.—J. physiol. et path. gén. 1917, v. 17, p. 436–443.

Schmidt, Harry B.: The effect of pituitary injections on the blood pressure of febrile patients.—Arch. Int. Med. 1917, v. 19, p. 1059–1061.

Mundell, Joseph J.: The present status of pituitary extract in labor. A general review.—J. Am. M. Assoc. 1917, v. 68, p. 1601–1604.

Rosenfeld, G.: Notes on the treatment of diabetes insipidus with pituitary extract.—Chem. Abstr. 1917, v. 11, p. 484.

Wertenbaker, William: A report of a case of spontaneous rupture of the uterus following the administration of pituitary solutions.—J. Am. M. Assoc. 1917, v. 68, p. 1612–1613.

LIQUOR MAGNESII CITRATIS.

Scoville, W. L.: The use of magma of magnesia and a 50 per cent solution of citric acid is recommended for the extemporaneous preparation of solution of magnesium citrate.—Bull. Pharm. 1917, v. 31, p. 262.

Lascoff, J. Leon: Changes made in the formula for the preparation of the solution of magnesium citrate, although good, may lead the pharmacists to purchase the preparation from manufacturers instead of preparing it themselves.—Am. Druggist, 1917, v. 65, No. 5, p. 25.

Anon.: If sodium bicarbonate is used in place of potassium bicarbonate for "charging" the solution of magnesium citrate, it should only be used in tablet form, as the liberation of the gas is so rapid when the powder is used that an explosion might result.—Drug. Circ. 1917, v. 61, p. 60.

Lea, E. J.: Of four samples of citrate of magnesia examined, two were rejected.—Rep. California Bd. Health, 1917, p. 162.

Pozen, M. A.: Of 45 samples of solution of magnesium citrate examined, 24 were rejected.—Rep. District of Columbia Health Off. 1917, p. 51.

Tice, William G.: Of 20 samples of solution of magnesium citrate examined, 11 were below standard.—Rep. New Jersey Dept. Health, 1917 62.

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LIQUOR PEPSINI AROMATICUS, N. F.

Hommell, P. E.: There can be no advantage of associating carminatives with pepsin to the extent that we find in this solution, as carminatives contain besides volatile oils, tannic acid, which is incompatible. What pepsin requires in solution or in powdered form is a certain percentage of hydrochloric acid.—Proc. New Jersey Pharm. Assoc. 1917, p. 83.

LIQUOR PHOSPHATUM COMPOSITUS, N. F.

Anon.: The N. F. formula for compound solution of phosphates is incorrect in that an excessive amount of water is directed to be used. The amount of water in the formula should be changed from 300 milliliters to 100 milliliters.—Drug. Circ. 1917, v. 61, p. 247.

LIQUOR POTASSÆ CHLORINATÆ, N. F.

Bury, A.: A description of a rapid volumetric method for the evaluation of Javelle water. The method consists in measuring the oxygen liberated when the solution of chlorinated potassa is allowed to act upon hydrogen peroxide in an alkaline medium.—J. pharm. et chim. 1917, v. 15, p. 189–193.

Cazin and Krongold, S.: Notes on the value of Javelle water in the treatment of infected wounds. Javelle water is stated to be superior to Dakin's solution because of its superior bactericidal properties and because it is less irritating.—Compt. rend. acad. sc. 1917, v. 165, p. 569–572.

LIQUOR POTASSII ARSENITIS.

Sjöström, F. W.: An investigation of the methods of various pharmacopœias for the evaluation of Fowler's solution and of its keeping qualities. Light was found to have but little influence on the oxidation of the solution, whereas the presence of certain organic compounds were found to aid oxidation.—Pharm. Ztg. 1917, v. 62, p. 120–122, through Ztschr. angew. Chem. 1917, v. 30, part 1, p. 174.

Engelhardt, H., and Winters, O. E.: Experimental data showing the rate of oxidation of arsenous acid to arsenic acid in Fowler's solution.—J. Am. Pharm. Assoc. 1917, v. 6, p. 134–136.

Schreinemakers, F. A. H., and DeBaat, Mej. W. C.: On the composition and properties of the arsenites of sodium.—Chem. Weekblad, 1917, v. 14, p. 262–267, 288–290.

Eskew, Harry L.: Of 48 samples of Fowler's solution examined, 11 were rejected for being below standard.—Rep. Tennessee F. & D. Dept. 1917, p. 15.

Hulbert, Roberts: One of three samples of Fowler's solution examined contained only 82 per cent of the required amount of As_2O_3.—Bull. North Dakota Exper. Sta. F. Dept. 1917. v. 4, p. 345.

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Dakin and Carlisle: Experiments showing how the Hermite process for electrolysis of sea water may be applied to the preparation of solution of sodium hypochlorite.—Year-Book of Pharmacy, 1917, p. 184.

Cullen, G. E., and Austin, J. H.: Notes on the preparation of Dakin's hypochlorite solution.—Proc. Soc. Exper. Biol. Med. 1917, v. 15, p. 41–42.

Anon.: A discussion of the Carrel-Dakin solution with directions for preparation and testing.—Midl. Drug. 1917, v. 51, p. 260–261.

Rosengart, Frederick: A description of a simplified method for the preparation of Carrel-Dakin solution.—J. Am. M. Assoc. 1917, v. 69, p. 175.

Thum, John K.: A general discussion of the origin and methods of preparation of the Carrel-Dakin solution.—J. Am. Pharm. Assoc. 1917, v. 6, p. 458–461.

Griffith, Ivor: The author gives the results of his experience in preparing Carrel-Dakin solution, and emphasizes the necessity of assaying the chlorinated lime used.—Proc. Pennsylvania Pharm. Assoc. 1917, v. 40, p. 237; see also Am. J. Pharm. 1917, v. 89, p. 497.

Anon.: A volume by Carrel and Dehelly, entitled "Traitment des Plaies Infectées," treats of the methods of preparing Carrel-Dakin solution and of its properties and uses.—Am. Drug. 1917, v. 65, p. 97.

Anon.: "Hychlorite" is the name used in New and Nonofficial Remedies to designate a commercial form of hypochlorite solution.—J. Am. M. Assoc. 1917, v. 69, p. 1081.

Overton, H. L.: The pink color sometimes noticed in hypochlorite solution is due to the formation of permanganic acid as a result of the presence of manganese as an impurity in the chlorinated lime.—Pharm. J. 1917, v. 98, p. 515.

Vanderkleed, Charles E., and E'we, George E.: Data showing the effects of manganese salts on the keeping qualities of sodium hypochlorite. The experiments indicate that only calcium hypochlorite, which yields a colorless and not a pink solution, is suitable for the manufacture of the solution of sodium hypochlorite.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 234.

Bouvet, M.: Data relative to the stability of concentrated solutions of sodium hypochlorite are presented. A solution containing 55.73 grams of active chlorine per liter showed practically no deterioration in 30 days when kept in the dark, but a very marked deterioration was noted in the same solution when exposed to sunlight.—Bull. sc. pharmacol. 1917, v. 24, p. 347–349.

Wischo, Fritz, and Frieberger, Franz: Data relative to the stability of Dakin's sodium hypochlorite solution are presented. Dilute [illegible]s were found to have lost 10 per cent in strength in two

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months whereas concentrated solutions lost 40 per cent in one month.—Münch. med. Wchnschr. 1917, v. 64, p. 1528–1529.

Wischo, Fritz: A note on the use of brucine-hydrochloric acid or brucine-sulphuric acid for the identification of chlorates in the presence of hypochlorites.—Pharm. Post, 1917, v. 50, p. 381, through J. Chem. Soc. Lond. 1917, v. 112, part 2, p. 539–540.

Dienert, F., and Wandenbulke, F.: A method for the estimation of free chlorine in hypochlorite solutions is described. Ammonium sulphate to the extent of 150 parts for every part of chlorine is added to the solution to be examined, after which potassium iodide is added, and the liberated iodine titrated with standard arsenious acid solution.—Compt. rend. acad. sc. 1917, v. 165, p. 28–29.

Bury, A.: A method for the volumetric analysis of hypochlorite solutions used for sterilizing water depends on the reaction which takes place between a hypochlorite and hydrogen dioxide.—J. pharm. et chim. 1917, v. 15, p. 189–195.

Anon.: A description of an iodometric method for the determination of free chlorine in solutions of sodium hypochlorite.—Compt. rend. acad. sc. 1917, v. 165, p. 28.

Fraser, John, and Bates, H. J.: A general article dealing with the antiseptic values of hypochlorous acid (eusol).—J. Roy. Army Med. Corps, 1916, v. 27, p. 79–84, through Chem. Abstr. 1917, v. 11, p. 171.

Fiessinger, Noël, and Clagne, René: A study of the antiseptic action of alkaline hypochlorites, with special reference to the solution of Dakin–Daufresne. An abstract.—Presse Med. 1917, v. 25, p. 407.

Barrett, M. T.: A note on the use of the Carrel-Dakin solution in the cleaning out of pyorrhea pockets.—Dental Cosmos, 1917, v. 59, p. 446–448.

A number of investigators: Notes on the use of the Carrel-Dakin solution in the treatment of wounds and infected areas.—J. Am. M. Assoc. 1917, v. 68, p. 110 and v. 69, p. 651, 1727 and 1994.

LIQUOR SODII CHLORIDI PHYSIOLOGICUS.

Chiaria, P.: Notes on the preparation of physiological salt solution.—Giorn. farm. chim. 1917, v. 66, p. 221–224.

LIQUOR ZINCI CHLORIDI.

Sjöström: A description of a titration method for the estimation of zinc in solutions of zinc chloride.—Farmacevtisk Revy, 1916, No. 35, p. 489, through Schweiz. Apoth.-Ztg. 1917, v. 55, p. 142–143.

LITHII CARBONAS.

Frerichs, G.: A description of a method for detecting the presence of magnesium carbonate in lithium carbonate.—Apoth.-Ztg. 1916, p. 453, through Pharm. Weekblad, 1917, v. 54, p. 766.

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LOBELIA.

Penick, S. B.: Lobelia is described in the U. S. P. as "the dried leaves and flowering tops of *Lobelia inflata* Linné, without the presence or admixture of more than 10 per cent of stems or other foreign matter." In the flowering tops there must be some stem, which would possibly be 10 per cent of the total, so that no more stem can be present if the drug strictly conforms to requirements. None of this drug will, therefore, be found on the market within 50 per cent of the U. S. P. requirements.—J. Am. Pharm. Assoc. 1917, v. 6, p. 696.

Snyder, J. P.: At present lobelia which meets the U. S. P. requirements is unobtainable. This is due to the fact that drug collectors are prone to gather the entire herb when only the leaves and flowering tops are specified.—J. Am. Pharm. Assoc. 1917, v. 6, p. 713.

Scoville, Wilbur L.: An assay for lobelia should be introduced into the next pharmacopœia. If not, good reasons based upon investigation should be given for not doing so.—Am. Druggist, 1917, v. 65, No. 1, p. 26.

van Leeuwen, W. Storm: A note on the physiological standardization of lobelia preparations.—Pharm. Weekblad, 1917, v. 54, p. 1332–1334.

Dohme, A. R. L.: One lot of lobelia examined failed to comply with the U. S. P. requirements, as it did not have the flowering tops and contained 60 per cent of the stem portion.—Proc. N. W. D. A. 1917, p. 515.

Anon.: The alkaloidal content of two samples of lobelia assayed was above standard.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 92.

LUPULINUM, N. F.

Dohme, A. R. L.: A variation of from 12.6 to 35.2 per cent of ash content showed 7 of 11 samples of lupulinum to be nonstandard drugs, the N. F. limit of ash being 16 per cent.—Proc. N. W. D. A. 1917, p. 510.

Engelhardt, H.: Five of the 12 samples of lupulin examined were deficient in ether-soluble constituents.—J. Am. Pharm. Assoc. 1917, v. 6, p. 411.

Roberts, J. G.: One sample of lupulin was rejected because it contained only 41.32 per cent of ether-soluble matter and yielded 34.56 per cent of ash.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 87.

Scoville, W. L.: The ash content of 14 samples of lupulin ranged between 8 and 44.8 per cent. Three of the samples yielded less than 10 per cent and three between 10 and 15 per cent.—J. Am. Pharm. Assoc. 1917, v. 6, p. 411.

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MAGMA FERRI HYDROXIDI, N. F.

Neidle, M., and Barab, J.: A rapid method for the preparation of the colloidal hydrous oxides of iron, chromium, and aluminum is described.—J. Am. Chem. Soc. 1917, v. 39, p. 71–81.

Pauli, W., and Matula, J.: A physico-chemical analysis of colloidal ferric hydroxide.—Kolloid-Ztschr. 1917, v. 21, p. 49–63, through J. Chem. Soc. Lond. 1917, v. 112, part 2, p. 563–564.

MAGMA MAGNESIÆ.

Mueller, Bertha: A more satisfactory magnesia magma is obtained if dry magnesium sulphate is substituted for the ordinary sulphate and the amount of water reduced.—Am. J. Pharm. 1917, v. 89, p 306–309.

Sayre et al.: Four of 13 samples of milk of magnesia examined were either high or low in $Mg(OH)_2$ content.—Rep. Kansas Bd. Health, 1917, v. 13, p. 170.

MAGNESII CARBONAS.

Utech, P. Henry: Magnesium carbonate has the power of absorbing many odors, its behavior in this respect being similar to that of willow charcoal. If allowed to remain in close contact with such aromatic substances as camphor, asafetida, naphthalene, etc., it is rendered practically unfit for pharmaceutic uses.—Drug. Circ. 1917, v. 61, p. 398.

Dohme, A. R. L.: One sample of magnesium carbonate examined was found to contain an excess of calcium and iron.—Proc. N. W. D. A. 1917, p. 515.

Gloor, F.: In some lots of magnesium carbonate examined as high as 9.97 per cent of calcium, calculated as calcium oxide, was found.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 87.

Roberts, J. G.: Magnesium carbonate (technical) is usually of U. S. P. quality, except that it contains an excess of calcium.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 87.

MAGNESII OXIDUM.

Snyder, J. P.: There appears to be very little calcined magnesia upon the market that will fulfill the U. S. P. requirements, as most of it contains an excess of moisture, assays low, and yields more calcium than is permitted in the official salt.—J. Am. Pharm. Assoc. 1917, v. 6, p. 714.

Astruc, A.: A discussion of the methods of examination and conditions as to purity given in the French Codex for calcined magnesia. Data obtained in the analysis of 26 commercial samples of the substance are presented.—J. pharm. et chim. 1917, v. 16, p. 65–77, 110–115.

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van der Haar, A. W.: In a report on the analyses of chemicals in Holland during the past few years it is stated that most of the samples of magnesium oxide tested contained at least 30 per cent of carbonate.—Pharm. Weekblad, 1917, v. 54, p. 256.

Roberts, J. G.: Two brokers' samples of magnesium oxide (light) were of undesirable quality. One lost 23.57 per cent of its weight upon ignition and contained 2.56 per cent of calcium. The other lot lost 58.03 per cent of its weight upon ignition and contained carbonates and an excess of calcium.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 87.

Dover, Mary V., and Marden, J. W.: A comparison of the efficiency of some common desiccants, including calcined magnesia.—J. Am. Chem. Soc. 1917, v. 39, p. 1609–1614.

MAGNESII SULPHAS.

Peacock, S.: U. S. patent No. 1205659 describes the manufacture of magnesium sulphate from serpentine, steatite, peridotite, and other minerals.—Chem. Abstr. 1917, v. 11, p. 192.

Nourse, A. L.: Magnesium sulphate, its history, properties, and uses.—Am. J. Clin. Med. 1917, v. 24, p. 501–504.

Cutler and Alton: The authors find that intraspinal injections of magnesium sulphate are of use in controlling the convulsions caused by strychnine poisoning.—J. Exper. M. 1917, v. 25, p. 83.

Morrison and Tullock: Observations on the use of a saturated solution of magnesium sulphate in the treatment of wounds.—Year-Book of Pharmacy, 1917, p. 185.

MALTUM.

Farwell, Oliver Atkins: The botanical source of malt is given as *Hordeum sativum* Jessen. This is but a synonym and should give way to the valid name, *Hordeum vulgare* Lin.—Drug. Circ. 1917, v. 61, p. 175.

Wiard, E. S.: Directions are given for grading graphite, gunpowder, and malt.—Met. Chem. Eng. 1917, v. 16, p. 654–655, through Chem. Abstr. 1917, v. 11, p. 2264.

MANGANI DIOXIDUM PRÆCIPITATUM.

Barnabey, O. L., and Hawes, W. C.: A report of experiments with the iodometric method for the determination of the available oxygen in soluble and precipitated oxidized forms of manganese.—J. Am. Chem. Soc. 1917, v. 39, p. 607–610.

Rupp, E.: A method for the evaluation of pyrolusite consists in adding 3 grams of KI, 3 grams of Na_2HPO_4, 10 cubic centimeters H_2O, and 10 cubic centimeters of 25 per cent H_3PO_4 to 0.2 gram of powdered sample, and titrating liberated iodine with

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0.1 N $Na_2S_2O_3$, using starch as an indicator.—Arch. Pharm. 1916, v. 254, p. 135–137, through J. Chem. Soc. Lond. 1917, v. 112, part 2, p. 390.

Barnabey, O. L.: A report of investigations relative to the determination of available oxygen in pyrolusite.—J. Ind. & Eng. Chem. 1917, v. 9, p. 961–967.

Witzemann, Edgar J.: Data showing the variations in the physical properties of precipitated and colloidal manganese dioxide from the point of view of physico-chemical equilibrium.—J. Am. Chem. Soc. 1917, v. 39, p. 25–33.

Engelhardt, H.: Several samples of black oxide of manganese were rejected for assaying below the U. S. P. requirements. They assayed from 60 to 61 per cent of MnO_2.—J. Am. Pharm. Assoc. 1917, v. 6, p. 411.

MANNA.

LaWall, Charles H., and Forman, Leroy: Experimental data are presented showing some of the physical and chemical properties of commercial samples of manna. The need for further work on the determination of the mannite content is emphasized.—J. Am. Pharm. Assoc. 1917, v. 6, p. 22–23.

Maske, Wm., jr.: Notes on the use of manna in the preparation of soft mass pills.—J. Am. Pharm. Assoc. 1917, v. 6, p. 1058–1059.

MASSA HYDRARGYRI.

Asher, Philip: An explanation of the U. S. P., IX, method for the assay of mass of mercury.—Am. J. Pharm. 1917, v. 89, p. 171.

Partridge, W.: A discussion of methods for the detection of rose petals in blue pill. The author does not agree with the statement of Dechan and Maben that the absence of a red color when the mass is digested with warm acetic acid and filtered indicates a substitution of confection of hops for the official excipient, confection of rose.—Analyst, 1917, v. 42, p. 171.

MASTICHE, N. F.

Lloyd, John Uri: On the oriental uses of gum mastic, including formulas for a number of preparations into which it enters.—Am. J. Pharm. 1917, v. 89, p. 1–8.

MATICO, N. F.

Farwell, Oliver Atkins: Matico is derived from *Piper granulosum* Ruiz et Pavon, which is the valid name for the species.—Drug. Circ. 1917, v. 61, p. 231.

MEL.

Atkins, W. R. G.: A description of a method for the analysis of honey and other substances containing levulose. The method is based on the oxidation of the dextrose with bromine.—Analyst, 1917, v. 42, p. 12–13.

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Gadamer, J., and Laske, K.: From experiments it is concluded that the precipitin reaction of Kraus and others is a trustworthy biological test for the identification of honey, since the honey albumin is independent of the plants visited and originates in the body of the bee.—Arch. Pharm. 1916, v. 254, p. 306–345, through Physiol. Abstr. 1917, v. 2, p. 461.

Shannon, F. L.: Data obtained by the use of various methods for the detection of artificial invert sugar in honey are presented. Bryan's modification of Fiehe's test is recommended as being the most suitable.—J. Assoc. Off. Agric. Chem. 1916, v. 2, p, 169–174.

Roberts, J. G.: A sample of Florida honey examined contained added invert sugar according to the U. S. P. test. All other samples were of U. S. P. quality.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 85.

Paul, Theodor: Directions are given for the preparation of artificial honey by inversion of sugar with lemon juice, and the subsequent addition of coloring and flavoring materials.—Südd. Apoth.-Ztg. 1916, v. 56, p. 272–273.

W. G. N. v. d. S.: A book review of a volume by Fr. Berger on the history and medicinal applications of honey and wax.—Chem. Weekblad, 1917, v. 14, p. 793.

Hortvet, Julius: Of 18 samples of honey examined, three were rejected because of poor quality.—Rep. Minnesota D. & F. Com. 1917, p. 25.

MELILOTUS, N. F.

Farwell, Oliver Atkins: The botanical name for this drug should read *Melilotus Melilotus officinalis* (Linné) Ascherson and Graebner.—Drug. Circ. 1917, v. 61, p. 231.

MENTHA VIRIDIS.

Farwell, Oliver Atkins: *Mentha spicata* Lin. is the older and valid name for the plant that has been more commonly known as *Mentha sylvestris*, and the spearmint of cultivation and of pharmacy is *Mentha viridis*. *Mentha spicata* should, therefore, be dropped.—Drug. Circ. 1917, v. 61, p. 175.

Dohme, A. R. L.: In two instances spearmint, which was examined, was odorless and practically devoid of leaves.—Proc. N. W. D. A., 1917, p. 521.

MENTHOL.

Hitchcock, Henry B.: A brief note on the preparation of menthol in Japan, with statistics showing the amount produced and exported during the years 1912 to 1916, inclusive.—Com. Rep. 1917, No. 183, p. 494.

Wright, Fred E.: Studies in the crystalization of menthol. Four different forms of crystals were obtained—i. e., α, β, γ, δ. Three of

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these apparently bear monotropic relations to the stable α form.—J. Am. Chem. Soc. 1917, v. 39, p. 1515–1524.

METHYLIS SALICYLAS.

Anon.: Owing to the scarcity of synthetic methyl salicylate, the birch-oil industry of Pennsylvania had been revived and distillation of the oil has been resumed with old-time vigor.—Am. Perf. 1917, v. 11, p. 323.

Anon.: In a test to differentiate between oil of wintergreen and methyl salicylate, the reagents used consist of sulphuric acid, to which has been added a small amount of an alcoholic solution of heliotropin, and sulphuric acid to which has been added an aqueous solution of chloral.—Am. Perf. 1917, v. 12, p. 202.

Rippetoe, J. R.: A simple test for distinguishing methylsalicylate from the oils of gaultheria and sweet birch depends on the froth resulting from agitation. Any froth produced by shaking immediately disappears on methylsalicylate, while on the oils of gaultheria and sweet birch it will remain for quite a few seconds.—Drug. Circ. 1917, v. 61, p. 502; J. Am. Pharm. Assoc. 1917, v. 6, p. 464.

Allbright, Allen R.: A description of a method for the detection of phenolic impurities in methylsalicylate.—J. Am. Chem. Soc. 1917, v. 39, p. 820–825.

Hortvet, Julius: Of six samples of wintergreen extract examined, two were rejected.—Rep. Minnesota D. & F. Com. 1917, p. 53.

Leone, G.: Methylsalicylate, when given, either orally or by hypodermic injection, has a marked influence on the biliary secretion. The percentage of total solids and of ash, also the viscosity and surface-tension of the bile, are lessened, but the total amount secreted is increased.—Pharm. J. 1917, v. 98, p. 439 from Chem. Abstr. 1917, v. 11, p. 995.

METHYLTHIONINÆ CHLORIDUM.

Tomioka, I.: A description of a method for preparing methylene blue from dimethylaniline.—J. Chem. Ind., Tokyo, 1917, v. 20, p. 1–2.

Dohme, A. R. L.: Of 17 samples of methylene blue examined, one had no appreciable ash, five showed 0.2 per cent to 0.88 per cent, and the remainder varied from 1.15 per cent to 25.3 per cent. All but the first five were unsatisfactory.—Proc. N. W. D. A. 1917, p. 510.

Scoville, W. L.: One sample of methylene blue examined yielded 49.6 per cent of ash.—J. Am. Pharm. Assoc. 1917, v. 6, p. 411.

Dohme, A. R. L.: One shipment of methylene blue examined was rejected because it contained about 5 per cent of zinc.—Proc. N. W. D. A. 1917, p. 521.

Monnier, A.: In a paper on the use of methylene blue as a reagent in chemical analysis, a method for applying it in the detection and estimation of periodates in Chili saltpeter is described. An abstract.—Analyst, 1917, v. 42, p. 51.

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Tribondeau: A method for the detection of methylene blue in urine consists of acidifying the latter with citric acid, adding a small amount of thymol, and boiling the mixture. The thymol collects on the surface, carrying with it the pigment.—Compt. rend. soc. biol. 1917, v. 80, p. 882.

MISTURA CHLORALIS ET POTASSII BROMIDI COMPOSITA, N. F.

Anon.: Comments on the N. F. method of preparing the compound mixture of chloral and potassium bromide.—N. A. R. D. J. 1917, v. 23, p. 941.

MISTURA CRETÆ.

Hommell, P. E.: The chalk mixture of the U. S. P. should be improved by adopting the following formula: Prepared chalk, 15 gm.; acacia in fine powder, 10 gm.; glycerin, 15 mils; cinnamon water, 150 mils; distilled water, sufficient to make 150 mils.—Proc. New Jersey Pharm. Assoc. 1917, p. 82.

MISTURA GLYCYRRHIZÆ COMPOSITA.

Hommell, P. E.: The compound mixture of glycyrrhiza can be improved. The gum acacia and spirit of nitrous ether in the formula are incompatible, resulting in precipitation. The acacia should be omitted, as it is of doubtful value in this preparation. Glycerin should be substituted, as it is a much better demulcent for the upper air passages. The sugar should be discarded, as it induces fermentation and upsets the stomach.—Proc. New Jersey Pharm. Assoc. 1917, p. 81.

MISTURA OPII ET RHEI COMPOSITA, N. F.

Raubenheimer, Otto: An improved formula for the preparation of sun cholera mixture.—Western Druggist, 1917, v. 39, p. 16.

MISTURA RHEI ET SODÆ.

Hommell, P. E.: The amount of glycerin in the mixture of rhubarb and soda should be reduced. At present, when a patient takes a teaspoonful of this compound, one-third of the dose is glycerin.—Proc. New Jersey Pharm. Assoc. 1917, p. 82.

MISTURA SASSAFRAS ET OPII, N. F.

Eskew, Harry L.: Of two samples of Godfrey's cordial examined, one was rejected for being below standard.—Rep. Tennessee F. & D Dept. 1917, p. 15.

MORPHINA.

Carles, P.: Notes on the nature of the insoluble morphine present in crude opium.—Farm. Españ. 1917, v. 49, p. 453–454.

Anon.: The quantity of morphine hydrochloride and sulphate [illegible]ed by Japan during 1916 amounted to 558,812 ounces, as com-

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pared with 358,543 ounces imported in 1915, and 180,760 ounces imported in 1914.—Chem. & Drug. 1917, v. 89, p. 305.

Dohme, A. R. L.: The committee on standards and deterioration of the American Drug Manufacturers' Association finds it desirable to determine whether or not morphine nitrate and acetate deteriorate, and also if they are desirable and necessary salts.—Proc. Am. Drug Mfg. Assoc. 1917, p. 185.

Rassers, J. R. F.: Observations on the specificity of the Straub-Herrmann biologic reaction for the identification of morphine. It was found that cocaine, caffeine, diuretin, camphor, picrotoxin, and tetanus toxin also give this reaction.—Physiol. Abstr. 1917, v. 2, p. 189.

Tunmann, O.: A description of a microchemical method for the differentiation of morphine and codeine. The method is based on the fact that morphine and codeine yield crystalline salts with hydriodic acid, which are different in form and therefore permit of the differentiation of the two bases.—Apoth.-Ztg. 1916, v. 31, p. 148–150, through Analyst, 1917, v. 42, p. 48.

Rakshit, J. N.: A method for the titration of morphine with iodic acid is described. The method can not be employed for the estimation of morphine in opium, since codeine, narcotine, and other substances contained in opium interfere.—J. Soc. Chem. Ind. 1917, v. 36, p. 989–990.

Heiduschka, A., and Faul, M.: Descriptions of colorimetric methods for the estimation of very small quantities of morphine are given. These methods are based on the use of George's and Gascard's iodic acid reagent and Marquis's reagent.—Arch. Pharm. 1917, v. 255, p. 172–191, through J. Chem. Soc. 1917, v. 112, part 2, p. 554.

Emery, W. O.: A description of a method for the estimation of caffeine, acetanilid, quinine, and morphine in mixtures containing these substances.—J. Assoc. Off. Agric. Chem. 1916, v. 2, p. 73–74.

Miller, M. R.: A description of a rapid method for the determination of small quantities of acetomorphine.—Ann. chim. analyt. 1917, v. 22, p. 59.

Faltis, F.: A critical review of most of the work dealing with the constitution of morphine, with an explanation for conflicting results.—J. Chem. Soc. Lond. 1917, v. 112, p. 411.

von Braun, J., et al.: A report of further researches dealing with the constitution and physiological activity of the morphine alkaloids.—J. Chem. Soc. 1917, v. 112, part 1, p. 163–164 and 281.

Mannich, C.: Researches on the chemical constitution of morphine, with special reference to the methyl derivatives of morphine.—Arch. Pharm. 1916, v. 254, p. 349–363, through J. Chem. Soc. Lond. 1917, v. 112, part 1, p. 473–475.

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Macht, David I.: A note on the absorption of apomorphine and morphine through the conjunctiva.—J. Am. M. Assoc. 1917, v. 68, p. 1230.

Biberfield, Johannes: A report of researches to determine the mechanism of tolerance to morphine acquired by the system on repeated administration of morphine.—Biochem. Ztschr. 1916, v. 77, p. 283–297, through J. Chem. Soc. Lond. 1917, v. 112, part 1, p. 106.

Wu Lien-Teh: The menace of morphine to China.—Lancet, 1917. v. 192, p. 874–875.

MORPHINÆ HYDROCHLORIDUM.

Schaefer, K., and Stich, C.: A note on the changes which take place in solutions of morphine hydrochloride upon sterilization in ampoules.—Apoth. Ztg. 1917, p. 274, through Pharm. Weekblad, 1917, v. 54, p. 1459.

MOSCHUS.

Anon.: Notes on the source and quality of the different commercial varieties of musk.—Perf. & Ess. Oil Rec. 1917, v. 8, p. 140–141,

MUCILAGO ACACIÆ.

Lascoff, J. Leon: The omission of limewater in the mucilage of acacia, U. S. P., IX, is an improvement as it will discourage the pharmacist from keeping large quantities of this preparation on hand, and will avoid the incompatibilities resulting from the presence of the limewater.—Am. Druggist, 1917, v. 65, No. 5, p. 25.

MUCILAGO SASSAFRAS MEDULLÆ, N. F.

DeG. Peacock, Josiah C., and Bertha L.: A presentation of experimental data concerning the preparation of the mucilage of sassafras pith and on its keeping qualities.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 171–185.

MUCILAGO TRAGACANTHÆ.

Nicholson, Malcolm: The tendency for fungus to grow in the mucilage of tragacanth is probably due to the presence of CO_2. To prevent the growth of fungus in the mucilage, use only distilled water which has been recently boiled.—Pharm. J. 1917, v. 98, p. 492.

MULLÆ.

Beringer, George M.: The title "mull" is applied by the N. F. to ointments of high fusing point which are to be spread on soft muslin, mull, and then applied like a plaster.—Proc. New Jersey Pharm. Assoc. 1917, p. 92.

Smith, F. A. Upshur: The class of "Unguenta Extensa" is now known by the shorter name mulla—a name first used by Unna, the originator of this group of preparations.—Proc. Minnesota Pharm. Assoc. [illegible] p. 173.

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MYRRHA.

Farwell, Oliver Atkins: Myrrh is said to come from one or more species of *Commiphora*. The oldest name and consequently the valid one is *Balsamea*. It should be adopted.—Drug. Circ. 1917, v. 61, p. 175.

Southard, Addison E.: The myrrh on the Aden market is stated to be obtained from Abyssinia and the Arabian hinterland, that from the former country being considered the best.—Com. Rep. 1917, No. 24, p. 377.

Dohme, A. R. L.: Samples of myrrh examined showed alcohol-soluble constituents of 32.4 per cent, 35.1 per cent, and 48.4 per cent, respectively.—Proc. N. W. D. A. 1917, p. 510.

Engelhardt, H.: The alcohol-soluble constituents of six samples of myrrh examined ranged from 27.4 to 38.6 per cent. The ash content varied from 3.8 to 7.6 per cent.—J. Am. Pharm. Assoc. 1917, v. 6, p. 411.

Green, C.: Seven lots of myrrh examined yielded 27.5 per cent, 32.9 per cent, 33.2 per cent, 34.1 per cent, 36 per cent, 39.9 per cent, and 50 per cent alcohol-soluble matter, respectively. Thus, three were above and four below the U. S. P. requirement of not less than 35 per cent of alcohol-soluble matter.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 87.

NEBULA AROMATICA, N. F.

Brown, L. A.: Nebula or oil sprays are a new class of preparations added to the N. F., IV. There are five of them—aromatic oil spray, eucalyptol, menthol, compound menthol, and thymol oil sprays.—Bull. Kentucky Agric. Exper. Sta. 1917, Feb. 15, p. 38.

Anon.: Notes on the preparation of aromatic oil spray.—N. A. R. D. J. 1917, v. 23, p. 765.

NITROGENII MONOXIDUM.

Tuckey, H. A.: A résumé of experiences with nitrous oxide-oxygen analgesia and anesthesia.—Dental Cosmos, 1917, v. 59, p. 400–405.

Casto, Theodore D.: An experimental study of the changes produced in the blood by nitrous oxide-oxygen anesthesia.—Dental Cosmos, 1917, v. 59, p. 415–432.

NUX VOMICA.

Hill: The seed of *Strychnose angustifolia*, *S. donnaiensis*, and *S. usitata* contain varying amounts of strychnine, and their possible presence in commercial samples of *S. nux vomica*, may account for the observed differences in the activity of the latter.—Chem. & Drug. 1917, v. 89, p. 43.

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Roberts, J. G.: Every lot of nux vomica examined contained more alkaloid than the U. S. P. standard. The results ranged from 2.5 per cent to 2.9 per cent of total alkaloids.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 88.

Anon.: Of 23 samples of nux vomica assayed, the alkaloidal content of 14 was above standard and 9 below.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 92.

OLEATUM HYDRARGYRI.

Asher, Philip: An assay process for the determination of the mercury content of the oleate of mercury should be included in the U. S. P.—Am. J. Pharm. 1917, v. 89, p. 175.

Beringer, George M.: The use of alcohol in place of water in the preparation of the oleate of mercury shortens the time necessary to complete the finished product and diminishes the danger of oxidizing the mercury.—Am. J. Pharm. 1917, v. 89, p. 352.

OLEORESINA.

Beringer, George M.: In the U. S. P., VIII, acetone was directed to be used in the preparation of the oleoresins on account of its cheapness. As it is now permissible to use denatured alcohol in the manufacture of ether, the latter can be made so cheaply that it has replaced acetone in the manufacture of this class of preparations in the U. S. P., IX.—Am. J. Pharm. 1917, v. 89, p. 14–15.

OLEORESINA ASPIDII.

Dohme, A. R. L.: The committee on standards and deterioration of the American Drug Manufacturers' Association states that the oleoresin of male fern placed on the market is a much inferior product. An assay process for filicin is desired.—Proc. Am. Drug Mfg. Assoc. 1917, p. 184.

Santí, Luigi: The method of the Ph. Helv. IV for the assay of the oleoresin of male fern is described and discussed.—Boll. chim.-farm. 1917, v. 56, p. 519–520.

Dohme, A. R. L.: Several samples of oleoresin male fern examined contained acetone. The percentage of crude filicin was less than 20 per cent, whereas a good product should contain from 26 to 28 per cent crude filicin.—Proc. N. W. D. A. 1917, p. 507.

Engelhardt, H.: Four samples of oleoresin of male fern yielded 19.7, 21.8, 22, and 24.3 per cent, respectively, of crude filicin when assayed by Fromme's method. Good oleoresin of male fern should contain 27 to 28 per cent. It would be advisable that the U. S. P. give an assay process for this product.—J. Am. Pharm. Assoc. 1917, v. 6, p. 112.

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OLEORESINA CUBEBÆ.

Santí, Luigi: A method for the evaluation of the oleoresin of cubeb is described. Cubebic acid is precipitated with calcium chloride in the presence of ammonia and the resulting precipitate, which is stated to be calcium salt of cubebic acid, is dried and finally weighed.—Boll. chim.-farm. 1917, v. 56, p. 521.

OLEA PINGUA.

Pigulevski, G. V.: An investigation of the influence of climatic conditions on the composition of plant oils.—J. Russ. Phys. Chem. Soc. 1916, v. 48, p. 324–341, through J. Chem. Soc. Lond. 1917, v. 112, part 1, p. 189.

Gardner, Henry A.: A tabulation of data showing the changes in the physical and chemical constants of vegetable and animal oils due to storage.—Oil, Paint & Drug Rep. 1917, v. 92, No. 9, p. 62.

Pickard, Glenn H.: Short notes on the production of some edible vegetable oils: Olive oil, cottonseed oil, peanut oil, corn oil, coconut oil, soya bean oil, palm kernel oil, and sesame oil.—Am. Food. J. 1917, v. 12, p. 668–672.

LeNaour, P.: A note on the neutralization of oils in general and olive oil in particular by the Rouhaud process. The neutralizing agent employed is $Na_2CO_3.10H_2O$ dissolved in 0.1 of its weight of water at 40° C.—J. pharm. et chim. 1917, v. 16, p. 243–246.

Fahrion, W.: A review of the developments in the chemistry and the analysis of fats during the year 1916.—Ztschr. angew. Chem. 1917, v. 30, part 1, p. 125–128, 138–140, 142–144, 147–148, 150–152, 157–159.

Alexander, Joh.: A review of the advances made in the fat, soap, and perfume industries in 1915.—Deut. Parfumerie-Ztg. 1916, v. 2, p. 65–66, 100–102, through Chem. Abstr. 1917, v. 11, p. 1014.

Anon.: Tentative standard methods for the sampling and analysis of commercial fats and oils, other than those of coconut, butter, and linseed group, adopted by the committee on the analysis of commercial fats and oils of the Division of Industrial Chemists and Chemical Engineers of the American Chemical Society are presented.—J. Ind. & Eng. Chem. 1917, v. 9, p. 1066–1070.

Houston, B. F.: A list of standards and definitions for edible vegetable fats and oils as adopted by the joint committee on definitions and standards.—S. R. A.-Chem. 1917, No. 19, p. 49–50.

Engelhardt, H.: A list of German substitutes for fats and oils, with directions for preparing the same.—J. Am. Pharm. Assoc. 1917, v. 6, p. 56–59.

Chéneveau, C.: Certain data showing the relation between the index of refraction and the chemical constitution of fats are presented.—Compt. rend. Acad. sci. 1917, v. 165, p. 1060–1062.

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Herzog: Some observations on the determination of the melting point of fats.—Schweiz. Apoth.-Ztg. 1917, v. 55, p. 325.

Gill, A. H.: The author has attempted to make use of the fact that different soap stocks require varying amounts of salt for salting out to develop a quantitative method for testing the purity of oils.—J. Ind. & Eng. Chem. 1917, v. 9, p. 136.

Marden, J. W., and Dover, M. V.: A description of a proposed method for the calorimetric determination of the sulphuric acid, or Maumé, number of fats and oils.—J. Ind. & Eng. Chem. 1917, v. 9, p. 858–860.

Issoglio, Giovanni: A new method for determining the degree of rancidity of fats consists of determining the oxidizability number. By the oxidizability number is meant the quantity of oxygen necessary to oxidize the volatile matter in 100 grams of oil or fat.—Giorn. farm. chim. 1917, v. 66, p. 245–250; Ann. chim. applicata, 1917, v. 7, p. 187–199.

Mazzaron: A method for determining the sulphuric-acid index of fatty oils is described in detail. Data of this nature obtained for certain oils are presented.—Oil, Paint & Drug Rep. 1917, v. 92, No. 28, p. 33.

Hodes, F.: A note on the use of a mixture of equal volumes of chloroform and alcohol instead of absolute alcohol in the estimation of hydroxy fatty acids in fats and oils.—Chem. Ztg. 1917, v. 41, p. 492, through J. Chem. Soc. Lond. 1917, v. 112, part 2, p. 429.

Lecoq, Raol: A description of a rapid method for the analysis of oils intended for use in the manufacture of soaps.—Bull. soc. chim. France, 1917, v. 21, p. 101–103.

Prescher, J.: A note on the separation of phytosterol and cholesterol from fats and oils by the digitonin precipitation method of Marcusson and Schilling.—Ztschr. Unters, Nahr. u. Genussm. 1917, v. 33, p. 77–80, through J. Chem. Soc. Lond. 1917, v. 112, part 2, p. 275–276.

Zwikker, J. J. L.: A method for the separation of sterins from fats is described. Expensive digitonin is replaced by a solution of lithium chloride in pyridine.—Pharm. Weekblad, 1917, v. 54, p. 101–102.

Wilkie, John M.: A description of an improved method for the estimation of unsaponifiable matter in oils, fats, and waxes.—Analyst, 1917, v. 42, p. 200–202.

Gill, A. H.: The color reaction for palm oil described by Crampton and Simons is criticized on the grounds that it is a test for carotin, and therefore will yield positive results with any oil containing the latter.—J. Ind. & Eng. Chem. 1917, v. 9, p. 136–139.

de Jong, D. J.: An investigation of the Jean method, the Franz-Adler method, and the solidification point method for detection of peanut oil in oils and fats are given.—Pharm. Weekblad, 1917, v. 54, p. 1390–1398.

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Margosches, B. M.: A method for the detection of rapeseed oil is based on the catalytic reduction of erucic acid.—Seifenseider-Ztg. 1917, v. 44, p. 91, through Chem. Zentralbl. 1918, v. 89, part 1, p. 776.

Normann, W., and Hugel, E.: Methods for the identification of hardened marine animal oils and rape oil are described.—Chem. Umschau, 1916, v. 13, p. 131–133, through J. Soc. Chem. Ind. 1917, v. 36, p. 658.

Tortelli, M., and Jaffe, E.: A description of a color reaction for distinguishing between fish oils and vegetable oils.—Hyg. Rundschau, 1916, p. 647, through Pharm. Weekblad, 1917, v. 54, p. 58.

Bolton, E. R., and Hewer, D. G.: Data are presented in the form of a table showing the physical and chemical constants of a number of fixed oils obtained from the seeds of Brazilian plants.—Analyst, 1917, v. 42, p. 35–45.

Pieraerts, J.: The composition and chemical and physical constants of oil of "sele"—an oil obtained from the seeds of a plant closely related to *Citrullus vulgaris*.—Bull. Sc. pharmacol. 1917, v. 24, p. 204–210.

Hewer, Dorothy G.: Analytical data relative to the physical and chemical constants of a fixed oil from orange pips are presented. The oil is stated to be easily saponifiable, and that it should prove suitable for the manufacture of soap and glycerol.—Analyst, 1917, v. 42, p. 271–273.

Pieraerts, J.: Analytical data showing the physical and chemical constants of the oil obtained from sanga-sanga nuts are given. The plant yielding these nuts is found in the lower Congo. An abstract.—Analyst, 1918, v. 43, p. 295.

Lackey, D. H., and Sayre, L. E.: An account of experiments in the hydrogenation of corn oil.—J. Am. Pharm. Assoc. 1917, v. 6, p. 348–351.

Scrauth, W.: Attention is directed to the possibility of employing the Varrentrapp reaction in the hydrogenation of unsaturated fats and oils. An abstract.—Analyst, 1917, v. 42, p. 91.

Langworthy, C. F., and Holmes, A. D.: Studies on the digestibility of some vegetable and animal fats.—U. S. Dept. Agric. Bull. 1917, No. 505 and 507.

OLEUM ADIPIS.

Windrath, R.: Notes on the use of olein in the manufacture of pharmaceutical preparations.—Pharm. Weekblad, 1917, v. 54, p. 339, from Apoth.-Ztg. 1917, p. 71.

OLEUM AMYGDALÆ EXPRESSUM.

Issoglio, Giovanni: Data showing the oxidizability number of different samples of expressed oil of almond are presented.—Giorn. farm. chim. 1917, v. 66, p. 246.

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Lea, E. J.: One sample of sweet almond oil examined proved to be an imitation product.—Rep. California Bd. Health, 1917, p. 150.

OIL, CHAULMOOGRA (NONOFFICIAL).

Brill, Harvey C., and Williams, Robert R.: A tabulation of the physical and chemical constants of 10 samples of chaulmoogra oil, and a discussion of the use of various fractions of chaulmoogra oil in the treatment of leprosy.—Philippine J. Sc. 1917, v. 12, sec. A, p. 207–220.

Brill, Harvey C.: A chemical investigation of the oil obtained from the seeds of *Pangium edule* and *Hydnocarpus alcalæ*, with reference to their use as substitutes for chaulmoogra oil.—Philippine J. Sc. 1917, v. 12, sec. A, p. 37–46.

Valenti, Adriano: A report of an investigation to determine the pharmacological action of chaulmoogra oil. The first part of the report deals with the origin and botanical description of the plant from which chaulmoogra oil is obtained, and the physical and chemical properties of the oil.—Arch. farmacol. sper. 1917, v. 24, p. 23–32, 33–49, 65–78.

OLEUM GOSSYPII SEMINIS.

Anon.: The joint committee on definitions and standards adopted the following definition for cottonseed oil: Cottonseed oil is the edible oil obtained from the seed of the cotton plant (*Gossypium herbaceum* L.) or from the seed of other species of Gossypium.—Chem. Abstr. 1917, v. 11, p. 896.

Beneschowsky, A.: The percentage of oleic acid in cottonseed oil was found to range from 2.43 to 6.08.—Chem. Zentralb. 1916, v. 1, p. 1274.

Rast, L. E.: Data relative to the oil content of cotton seed are presented. The results obtained in 500 determinations showed that the oil content is an inherent characteristic of the variety and can be increased by selection.—Science, 1917, v. 45, p. 507–508.

Langworthy, C. F., and Holmes, A. D.: A report of investigations to determine the digestibility of cottonseed oil, olive oil, peanut oil, coconut oil, sesame oil, and cacao butter.—Bull. U. S. Dept. Agric. 1917, No. 505, p. 1–19.

OLEUM LINI.

Weiss, A.: A discussion of the sources of linseed oil, its properties and method of purification by refining and bleaching.—Seifenfabrikant, 1916, v. 36, p. 601–603, 617–619.

Holley, C. D.: A discussion of specifications for linseed oil.—Proc. Am. Soc. Testing Materials, 1916, v. 2, p. 239–247, through Chem. Abstr. 1917, v. 11, p. 405.

Anon.: A book review calls attention to a monograph by J. Newton Fr[illegible] entitled *The Chemistry of Linseed Oil*.—Pharm. J. 1917, v.

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Friend, John A. N.: An investigation of the effect of heat and oxidation on linseed oil.—J. Chem. Soc. Lond. 1917, v. 111, p. 162–167.

Sacher, J. F.: When granular boneblack is added to mineral oils the layer of black material shows a decided Paris blue color when viewed in reflected light. By this means 3.5 to 4 per cent of mineral oil can be detected in linseed and rapeseed oils.—Farben-Ztg. 1916, v. 21, p. 1012, through Chem. Abstr. 1917, v. 11, p. 1322.

Table showing some of the analytical results reported for linseed oil.

Reporter.	Number of samples.		References.
	Examined	Rejected.	
Barnard, H. E.....	7	2	Bull. Indiana Bd. Health, 1917, v. 20, p. 159 & 221.
Casey, F. W.....	11	7	Bull. Michigan D. & F. Dept. 1917, No. 260-261, p. 33 and No. 262-263, p. 13.
Hortvet, Julius.....	12	6	Rep. Minnesota D. & F. Com. 1917, p. 25.
Indiana Board of Health.....	16	3	J. Am. Pharm. Assoc. 1917, v. 6, p. 412.
Sayre et al.....	3	1	Rep. Kansas Bd. Health, 1916, v. 12, p. 429.

OLEUM MORRHUÆ.

Scoville, W. L.: It has been difficult to obtain cod liver oil of satisfactory quality. Most samples are dark in color and unpleasant in taste. It is impossible to insist on a high grade of oil at the present time and secure supplies.—J. Am. Pharm. Assoc. 1917, v. 6, p. 412.

Anon.: New regulations in Newfoundland require that all refined cod liver oil be inspected before exportation, and be branded as "nonfreezing cod liver oil for human consumption," and "refined cod liver oil for human consumption."—Bull. Imp. Inst. 1917, v. 15, p. 582.

Bull, Henrik: Researches on the composition of cod liver oil. On bromination, a product consisting of a mixture of $C_{20}H_{30}Br_{10}O_2$ and $C_{20}H_{28}Br_{12}O_2$ was obtained.—Tidskr. Kemi, Farm. Therapi, 1917, v. 14, p. 1–2.

Chapman, A. C.: A sample of cod liver oil, which was thought to be adulterated with petroleum oil on account of its high hydrocarbon content was found to contain oil from the livers of fish, belonging to the *Spinacidæ* or *Squalidæ*. Oils obtained from the livers of certain fish belonging to this family contain a high percentage of hydrocarbon. The author proposes the name of spinacene for the hydrocarbon isolated.—Analyst, 1917, v. 42, p. 161-168.

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Condelli, S.: A description of a method for the detection of mineral oils, vaselin, and paraffin in fish oils. An abstract.—Giorn. farm. chim. 1917, v. 66, p. 174; Boll. chim.-farm. 1917, v. 56, p. 97-98.

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Issoglio, G.: Cod liver oil which is of a reddish or brownish-yellow color should not be used in medicine, since it is almost certain to have undergone some decomposition and will show a high oxidizability value. Data showing the color, acid value, iodine value, and oxidizability value of samples of cod liver oil of different origin are presented in tabular form.—Giorn. farm. chim. 1917, v. 66, p. 249-250; Ann. chim. applicata, 1917, v. 7, p. 187-199.

Dohme, A. R. L.: Some of the samples of cod liver oil examined were of high grade, but that of satisfactory quality is not easy to obtain.—Proc. N. W. D. A. 1917, p. 510.

Richmond, H. D., and Hitchman, F. G.: A description of a specific gravity method for the rapid determination of cod liver oil in malt and oil preparations.—J. Soc. Chem. Ind. 1917, v. 36, p. 273.

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OLEUM OLIVÆ.

Anon.: The joint committee on definitions and standards adopted the following definition for olive oil: Olive oil (sweet oil) is the edible oil obtained from the sound, mature fruit of the olive tree (*Olea europaea L.*).—Chem. Abstr. 1917, v. 11, p. 896.

Hurst, Carl B.: Spanish law forbids the adulteration of olive oil intended for exportation from Spain. Hence the olive oil of Spain is in a measure guaranteed by the government as to its purity.—Com. Rep. 1917, No. 42, p. 677.

Cutulo, A.: An investigation of the effects of acidity and rancidity on the index of refraction of olive oil. Although free fatty acids were found to lower the value, rancidity caused it to increase.—Staz. sper. agric. ital. 1916, v. 49, p. 377-387, through Chem. Abstr. 1917, v. 11, p. 2124.

Rippetoe, J. R.: It is desirable that the Pharmacopœia specify a limit of free acid in olive oil.—Drug. Circ. 1917, v. 61, p. 502; J. Am. Pharm. Assoc. 1917, v. 6, p. 464.

Cordier, G., and Lesure, A.: A description of a new process for removing the rancidity from olive oil in order to obtain a product sufficiently pure to be employed in the preparation of camphorated oil for injections.—J. pharm. et chim. 1917, v. 15, p. 369-382.

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Lund, R.: A description of a method for the quantitative determination of peanut oil in olive oil. The method is based on the difference in the crystallization temperature of alcoholic fatty acid mixtures of pure olive oil and pure peanut oil.—Am. Perf. 1917, v. 12, p. 89.

Hortvet, Julius: Of 32 samples of olive oil examined, 6 were rejected.—Rep. Minnesota D. & F. Com. 1917, p. 25.

Lea, E. J.: Eight samples of olive oil were rejected, as they contained cottonseed oil.—Rep. California Bd. Health, 1917, p. 150.

Price, J. D.: Twenty-eight samples of olive oil tested were of U. S. P. quality.—Bull. Georgia Dept. Agric. 1917, v. 4, No. 1, p. 15–17.

Roberts, J. G.: One sample of olive oil examined was rejected on account of its high saponification and acid numbers.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 88.

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Fahrion, W.: Analytical data relative to the identity and properties of the acids present in castor oil are presented and discussed.—Chem. Zentralbl. 1916, v. 2, p. 580, through Chem. Abstr. 1917, v. 11, p. 1325.

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Farwell, Oliver Atkins: The proper binomial for the designation of sesame is *Sesamum orientale* Lin.; not *Sesamum indicum* Lin.—Drug. Circ. 1917, v. 61, p. 175.

Anon.: The joint committee on definitions and standards adopted the following definition for sesame oil: Sesame oil (Gingili oil, teel oil, benne oil) is the edible oil obtained from the seed of the sesame plant (*Sesamum indicum*, De Candolle; *Sesamum radiatum*, Schum and Thonn; *Sesamum orientale* L.).—Chem. Abstr. 1917, v. 11, p. 896.

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Scoville, W. L.: Artificial substitutes for the natural oils are increasing. The oils of coriander, rose, neroli, and cinnamon (Ceylon) are mostly of the artificial variety. It is needless to say that they are not as satisfactory as the natural oils, but the latter are not always obtainable.—J. Am. Pharm. Assoc. 1917, v. 6, p. 412.

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Sernagitto, E.: A study of the oxidation of terpenes in the light.—Gazz. chim. ital. 1917, v. 47, part 1, p. 150–153.

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Kremann, R.: From experiments it is concluded that heavy oil of wine is a mixture of ethyl sulphate, and a compound of ethyl sulphate with unsaturated hydrocarbons.—Monatsh. Chem. 1917, v. 38, p. 53–62, through J. Soc. Chem. Ind. 1917, v. 36, p. 905.

OLEUM AMYGDALÆ AMARÆ.

Farwell, Oliver Atkins: According to the laws of priority the proper designation of bitter almond under *Prunus* is *Prunus Com-*

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munis (Lin.) Farwell. It is not necessary to use the variety *amara* for the bitter almond, as it is but a synonym of the species.—Drug. Circ. 1917, v. 61, p. 173.

Asher, Philip: An explanation of the chemistry of the U. S. P., IX, method of assay for oil of bitter almond.—Am. J. Pharm. 1917, v. 89, p. 119.

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Hood, S. C.: On the relative oil yield of Florida oranges. A table showing the yield of a number of different varieties is given.—Am. Perf. 1917, v. 12, p. 297–298.

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Farwell. Oliver Atkins: The botanical origin of bitter orange should read *Citrus Aurantium* Linné; the "amara" between the words "*Aurantium*" and "Linné" is superflous.—Drug. Circ. 1917, v. 61, p. 231.

OLEUM AURANTII FLORUM, N. F.

Anon.: Notes on the properties of the oil of orange flowers when prepared by different methods.—Perf. & Ess. Oil Rec. 1917, v. 8, p. 129–131.

OLEUM BERGAMOTTÆ, N. F.

Farwell, Oliver Atkins: The words "Linné" and "variety," or its abbrevation "var.," should be inserted between the words "*Aurantium*" and "*Bergamia.*" Wight and Arnot describe a variety not a subspecies.—Drug. Circ. 1917, v. 61, p. 231.

Anon.: A short, concise account of the preparation of bergamot oil.—Perf. & Ess. Oil Rec. 1917, v. 8, p. 128–129.

Parry, E. J.: Although bergamot oil generally shows a rotatory power below 20°, the 1916–1917 crop from Messina has a rotatory power of 24–25° or more.—Perf. & Ess. Oil Rec. 1917, v. 8, p. 159.

Reutter: A method for the detection of triacetin when it occurs as an adulterant in oil of bergamot. The method depends on the liberation of glycerin by means of potassium bisulphate and the subsequent conversion of the glycerin into acrolein by means of heat. An abstract.—Schweiz. Apoth.-Ztg. 1916, v. 54, p. 183.

Lea, E. J.: Three samples of oil of bergamot examined proved to be imitation products.—Rep. California Bd. Health, 1917, p. 150.

OLEUM CADINUM.

Dohme, A. R. L.: Much of the oil of cade examined was largely adulterated with pine tar.—Proc. N. W. D. A. 1917, p. 521.

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OLEUM CAJUPUTI.

Farwell, Oliver Atkins: The proper binomials for cajaput are *Kajuputi Leucadendron* (Lin.) Farwell var. *Augustifolia* (Lin. fil.) Farwell, and *Kajuputi Leucadendron* (Lin.) Farwell var. *Minor* (Sm.) Farwell.—Drug. Circ. 1917, v. 61, p. 175.

Anon.: Notice of judgment No. 4536 relates to the adulteration of oil of cajuput.—S. R. A.-Chem. 1917, p. 51.

OLEUM CASSIÆ.

Asher, Philip: An explanation of the chemistry of the U. S. P., IX, method for the assay of oil of cinnamon.—Am. J. Pharm. 1917, v. 89, p. 119.

Anon.: Lead is removed from the oil of cassia by vigorously shaking it with tartaric acid and filtering.—Schimmel's Rep. Oct. 1916, through J. Soc. Chem. Ind. 1917, v. 35, p. 100.

Engelhardt, H.: One lot of cassia oil was rejected because it contained both lead and rosin.—J. Am. Pharm. Assoc. 1917, v. 6, p. 411.

Anon.: Notice of judgment No. 4667 relates to the adulteration of oil of cinnamon.—S. R. A.-Chem. 1917, p. 220.

OLEUM CHENOPODII.

Farwell, Oliver Atkins: The U. S. P. gives the source of the oil of chenopodium as *Chenopodium ambrosiodes anthelminticum* (Linné). The author citation for the variety *anthelminticum* is (Linné) A. Gray. Linneas is not the author of a subspecies *anthelminticum*.—Drug. Circ. 1917, v. 61,p. 175.

Salant, William: The pharmacology of the oil of chenopodium, with suggestions for the prevention and treatment of poisoning.—J. Am. M. Assoc. 1917, v. 69, p. 2016–2017.

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Walker, Ernest L., and Emrich, William: A report on the treatment of carriers of *Endamœba histolytica* with oil of chenopodium.—J. Am. M. Assoc. 1917, v. 68, p. 1456–1457.

OLEUM EUCALYPTI.

Dohme, A. R. L.: The committee on standards and deterioration of the American Drug Manufacturers' Association states that a more convenient form of assay for cineol is desirable.—Proc. Am. Drug. Mfg. Assoc. 1917, p. 184.

Anon.: A short, concise account of the sources of oil of eucalyptus and the development of the industry in the distillation of the oil.—Perf. & Ess. Oil Rec. 1917, v. 8, p. 123–125.

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Singh, Puran: A note on the eucalyptus oil industry in the Nilgiris. Data showing the characteristics of the oil obtained are presented.—Indian Forest Records, 1917, v. 5, part 8, p. 1–26, through Chem. Abstr. 1918, v. 12, p. 848.

OLEUM GAULTHERIÆ.

Singh, Puran: An account of the production of wintergreen oil in India. The physical and chemical constants of the oil obtained from *Gaultheria fragrantissima* Wall. are given.—Indian Forest Records, 1917, v. 5, part 8, p. 33–39, through Chem. Abstr. 1918, v. 12, p. 848. See also Com. Rep. 1917, No. 256, p. 440.

Anon.: Notices of judgment Nos. 4596 and 4704 relate to the adulteration of oil of wintergreen.—S. R. A.-Chem. 1917, p. 134 and 265.

OLEUM JUNIPERI.

Engelhardt, H.: A shipment of oil of juniper berries consisted largely of oil of turpentine. It is to be regretted that neither the present nor the forthcoming Pharmacopœia gives tests to detect any appreciable adulteration of oil of juniper berries with oil of turpentine.—J. Am. Pharm. Assoc. 1917, v. 6, p. 412.

OLEUM LAVANDULÆ.

Farwell, Oliver Atkins: The valid designation of the lavender plant is *Lavendula Spica* Linné, not *Lavandula vera* D. C.—Drug. Circ. 1917, v. 61, p. 175.

Anon.: A short, concise account of the cultivation of lavender flowers and the extraction of the essential oil therefrom.—Perf. & Ess. Oil Rec. 1917, v. 8, p. 122–123.

Parry, E. J.: An African sample of oil of spike lavender has a specific gravity of 0.894 and an optical rotation of $-10° 30'$. It contained 3 per cent of esters and 44.1 per cent of alcohols.—Perf. & Ess. Oil Rec. 1917, v. 8, p. 263.

OLEUM LIMONIS.

Parry, E. J.: The rotatory power of oil of lemon may vary from $+53°$ to $+54°$, depending on the season, and it is especially difficult to fix pharmaceutical limits, as the rotatory power is generally low when the citral value is high.—Perf. & Ess. Oil Rec. 1917, v. 8, p. 159.

Honey, Robertson: The oil of lemon produced in Eastern Sicily during 1916–17 is noteworthy for its unusually high optical rotation, the majority of the samples having shown a rotation of 61° to 64°. The citral content, however, is stated to be low as compared with the previous year.—Com. Rep. 1917, No. 77, p. 19.

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Scoville, W. L.: Both the natural and concentrated oils of lemon are frequently low in citral content.—J. Am. Pharm. Assoc. 1917, v. 6, p. 412.

Scoville, Wilbur L.: The citral-containing oils lose their flavoring power to a great extent unless kept perfectly dry and free from exposure to light and air.—Bull. Pharm. 1917, v. 31, p. 123.

Wilson, C. P., and Young, C. O.: A description of a method for the determination of the volatile oil content of citrus fruits.—J. Ind. & Eng. Chem. 1917, v. 9, p. 959–961.

OLEUM MENTHÆ PIPERITÆ.

Fuller, H. C.: The standard for oil of peppermint is altogether too limited in its scope. Oils of excellent flavoring quality distilled directly from the plant often contain much less menthol than the U. S. P. prescribes.—J. Am. Pharm. Assoc. 1917, v. 6, p. 71.

OLEUM MYRCIÆ, N. F.

Farwell, Oliver Atkins: The proper author citation for *Pimenta acris* is (Swartz) Kostel, not Wight.—Drug Circ. 1917, v. 61, p. 231.

Anon.: The reason why the Islands of St. Thomas and St. Jan have long been noted for producing the best bay oil is probably because of the fact that the "lemoncillo," or false bay oil tree, does not grow there.—Pharm. J. 1917, v. 98, p. 489.

Tempany, H. A.: Data showing the specific gravity and phenol content of bay oil from Montserrat.—Perf. & Ess. Oil Rec. 1917, v. 8, p. 160.

OLEUM PIMENTÆ.

Farwell, Oliver Atkins: *Pimenta Pimenta* (Linné) Lyons is the valid binomial for the source of this product, not *Pimenta officinalis* Lindley, as given in the U. S. P.—Drug. Circ. 1917, v. 61, p. 175.

OLEUM PINI PUMILIONIS.

Anon.: A pine needle oil two and one-half times more concentrated than the oil obtained from Siberian pine needles is produced by Buettner. It contains 73 to 74 per cent of bornyl acetate and boils at 230° C. An abstract.—Drug. Circ. 1917, v. 61, p. 20.

OLEUM ROSÆ.

Anon.: Statistics relative to the production of oil of rose in Bulgaria are given.—Am. Drug. 1917, v. 65, p. 59.

Parry, Ernest J.: Data showing the physical and chemical constants of the French otto of rose are presented.—Perf. & Ess. Oil Rec. 1917, v. 8, p. 6–8.

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OLEUM ROSMARINI.

Parry, E. J.: An African sample of oil of rosemary examined had a specific gravity of 0.908 and an optical rotation of 1.0°. It contained 4 per cent of esters and 15 per cent of alcohols.—Perf. & Ess. Oil Rec. 1917, v. 8, p. 263.

Pigulevskii, G. V.: Tables are given showing the rotation, dispersion coefficient, and specific gravity of oil of rosemary.—J. Russ. Phys. Chem. Soc. Proc. 1916, v. 48, p. 1047–1048, through Chem. Abstr. 1917, v. 11, p. 3380.

OLEUM SABINÆ.

Dohme, A. R. L.: Of the samples of oil of savin examined, a number were adulterated with oil of turpentine. Two shipments were found to consist of French oils, instead of true oil of savin.—Proc. N. W. D. A. 1917, p. 521.

Roberts, J. G.: One lot of oil of savin which was received before the U. S. P., IX, was in force was rejected, as it had a specific gravity of 0.867 and an optical rotation of $-7° 21'$. The U. S. P., VIII, required a specific gravity ranging from 0.903 to 0.923 and an optical rotation ranging from $+40°$ to $+60°$ —Proc. Pennsylvania Pharm. Assoc. 1917, p. 88.

OLEUM SANTALI.

Anon.: Notes on the production of sandalwood oil in Mysore.—Bull. Imp. Inst. 1917, v. 15, p. 108–111.

Konppa, Gust., and Hintikka, S. V.: A report of researches on the complete synthesis of satene.—Bull. soc. chim. France, 1917, v. 21, p. 13–19.

Lea, E. J.: Two so-called samples of sandalwood oil examined were rejected, as they consisted principally of substitute materials.—Rep. California Bd. Health, 1917, p. 150.

OLEUM SINAPIS VOLATILE.

Asher, Philip: An explanation of the chemistry of the U. S. P. method of assay for the volatile oil of musrard.—Am. J. Pharm. 1917, v. 89, p. 120.

Van Kampen, G. B.: Chemistry of the essential oils of mustard. The influences of thymol on the quantitative estimation of mustard oils is discussed.—Olien en Vetten, 1917, v. 2, p. 156–159, through Chem. Weekbl. 1917, v. 14, p. 1157.

OLEUM TEREBINTHINÆ.

Harkort, H.: An account of the production of oil of turpentine in Poland.—Ztschr. angew. Chem. 1916, v. 29, part 1, p. 361–363, through Chem. Abstr. 1917, v. 11, p. 1295.

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Palazzo, M.: Physical and chemical properties of Italian oil of turpentine obtained from *Pinus pinaster*.—Ann. chim. applicata. 1917, v. 7, p. 88; J. Soc. Chem. Ind. 1917, v. 36, p. 463.

Palazzo, F. C.: Data obtained in the determination of the physical and chemical constants of the volatile oil obtained from the oleoresin of *Pinus pinea*.—Chem. Abstr. 1917, v. 11, p. 97.

Halse, O. M., and Dedichen, Herman: A report of a chemical investigation of the turpentine oil obtained in the treatment of wood for cellulose by the sulphite process.—Ber. deutsch. chem. Gesellsch. 1917, v. 50, p. 623–630, through J. Chem. Soc. Lond. 1917, v. 112, part 1, p. 398.

Tsakalotos, D. E.: Observations on the value of the determination of the optical activity of turpentine oils as a means of identifying the species of pines.—Gazz. chim. ital. 1917, v. 47, part 1, p. 285–287.

Anon.: A comprehensive discussion of the various methods employed in the adulteration of oil of turpentine. Rosin oil and "white spirit," a petroleum distillate with hardly any petroleum odor, are mentioned as common adulterants.—Ann. Falsif. 1917, v. 10, p. 33–47.

Anon.: Notes on the adulteration of oil of turpentine. An abstract.—Schweiz. Apoth.-Ztg. 1917, v. 55, p. 350.

Patch, E. L.: A sample of oil of turpentine examined had a specific gravity of 0.8435 and a refractive index of 1.4622 at 20° C. The sample contained a notable quantity of kerosene.—J. Am. Pharm. Assoc. 1917, v. 6, p. 412.

OLEUM THYMI.

Dohme, A. R. L.: One shipment of oil of red thyme examined contained practically no phenols.—Proc. N. W. D. A. 1917, p. 521.

OPIUM.

Scidmore, George H.: The cultivation of the opium poppy in Japan has been extended, and the output of opium amounted to about 2,535 pounds.—Com. Rep. 1917, No. 179, p. 418.

Kehl, John E.: It is stated that the quality of eastern Macedonian opium harvested in 1916 is better than usual, the morphine content being 1 per cent higher than in normal years. The quantity produced in Greek and Serbian Macedonia during 1916 is estimated to be about 15,000 pounds.—Com. Rep. 1917, No. 30, p. 469.

Tunmann. O.: A description of a method for the identification of opium by means of meconine and meconic acid.—Apoth.-Ztg. 1916, v. 31, p. 499–500 and 503–504, through J. Chem. Soc. Lond. 1917, v. 112, part 2, p. 226.

Dohme, A. R. L.: The amount of slaked lime used in the opium assay is too great and should be reduced.—Proc. N. W. D. A. 1917, p. 502–503.

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Anon.: In order to overcome the inconveniences attending the U. S. P. assay of opium, the H. K. Mulford Co. suggests that the alkaloids be extracted by maceration in a wide-mouthed bottle instead of by trituration in a mortar. Working directions for the modified method are given.—Drug. Circ. 1917, v. 61, No. 8, p. 25.

Rakshit, J. N.: Attention is called to the fact that ammonia is given off when opium is mixed with slaked lime in the assay process of the Ph. Brit.—Pharm. J. 1917, v. 98, p. 255.

Carles, P.: A discussion of the conflicting reports relative to the presence of insoluble morphine in crude opium.—Répert. pharm. 1917, v. 28, p. 1–3; J. pharm. et chim. 1917, v. 15, p. 44–47.

Faltis, Franz: A critical review of the work of Knorr, Freund, and Braun on the constitution of morphine.—Arch. Pharm. 1917, v. 255, p. 85–112, through J. Chem. Soc. Lond. 1917, v. 112, part 1, p. 411.

Von Braun, J., et al.: A report of researches dealing with the constitution of the morphine alkaloids.—Ber. deutsch. chem. Gesellsch. 1916, v. 49, p. 2655–2663; ibid. 1917, v. 50, p. 43–44, through J. Chem. Soc. Lond. 1917, v. 112, part 1, p. 163 and 281.

Borsche, W.: Researches on the constitution of meconic acid.—Ber. deutsch. chem. Gesellsch. 1916, v. 49, p. 2538–2546, through J. Chem. Soc. Lond. 1917, v. 112, part 1, p. 117.

Freund, Martin, and Speyer, Edmund: A report of researches dealing with the conversion of thebaine into hydroxycodeinone and its derivatives.—J. prakt. Chem. 1916, v. 94, part 2, p. 135–178, through J. Chem. Soc. Lond. 1917, v. 112, part 1, p. 217.

Webster, John: Analytical notes on the detection of morphine in the organs and body fluids in cases of acute and chronic cases of opium poisoning.—Analyst, 1917, v. 42, p. 226–229.

Macht, David I., and Fisher, Homer G.: A study of the toxic action of opium alkaloids, individually and in combination with each other, on paramœcia.—J. Pharmacol. & Exper. Therap. 1917, v. 10, p. 95–104.

Af Klercker, K. O.: The inhibiting action of opium on hyperglucæmia after the ingestion of carbohydrates is an indirect result of the inhibiting effect of opium on the evacuation of the stomach. It may also act directly on the increase of glucose in the blood during fasting, and thus diminish both hyperglucæmia and glucosuria.—Pharm. J. 1917, v. 98, p. 439; Chem. Abstr. 1917, v. 11, p. 628.

Fowler, H. A.: Experiences with papaverin in the treatment of urethral calculus. An abstract.—J. Am. M. Assoc. 1917, v. 68, p. 1662.

OVI ALBUMEN RECENS, N. F.

Rakuzin, M. A., and Flier, G. D.: Data relative to the specific gravity of aqueous solutions of egg albumen are presented.—J. Russ. Phys. Chem. Soc. 1916, v. 48, p. 458–461, through J. Soc. Chem. Ind. 1917, v. 36, p. 301.

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Jansen, B. C. P.: A description of an accurate method for the determination of arginine in egg albumen.—Chem. Weekbl. 1917, v. 14, p. 124–129.

Rakuzin, J., and Braudo, E. M.: An investigation of the behavior of ferric and aluminum hydroxides toward egg albumen.—J. Russ. Phys. Chem. Soc. 1916, v. 48, p. 95–97, through J. Soc. Chem. Ind. 1917, v. 36, p. 301.

Verkade, P. E.: A general survey of the progress made in the synthesis of the albumins.—Chem Weekbl. 1917, v. 14, p. 89–104.

OVI VITELLUM RECENS, N. F.

Barbieri, N. A.: From experiments it is concluded that lecithin containing glycerol, phosphoric and stearic acids, is not present in egg yolk.—Gazz. chim. ital. 1917, v. 47, part 1,.p. 1–37.

Steenbock, H.: An account of the extraction of an antineuritic substance from egg yolk. The substance is incompletely precipitated by phosphotungstic acid and is stable to concentrated hydrochloric acid and alkalies at room temperature.—Proc. Am. Soc. Biol. Chem., J. Biol. Chem. 1917, v. 29, p. XXVII.

Levene, P. A., and Meyer, G. M.: Some analytical data relative to the composition of cerebrosides of egg yolk are presented.—J. Biol. Chem. 1917, v. 31, p. 649–654.

OVUM GALLINACEUM, N. F.

Postolka, August: An investigation of conditions favorable for and the effects of the growth of molds in eggs.—Chem. Zentralbl. 1916, v. 2, p. 755, through Chem. Abstr. 1917, v. 11, p. 2215.

Rullmann, W.: An investigation of the bacteria and catalase content of eggs.—Chem. Zentralbl. 1916, v. 1, p. 1178, through Chem. Abstr. 1917, v. 11, p. 2509.

Bostock, H. D.: U. S. patent No. 1212445 describes the preservation of eggs by means of a solution consisting of *Desmodium tortuosum meibomia*, 1 pound, and water, 1 gallon.—Chem. Abstr. 1917, v. 11, p. 856.

Subirana I.: Swiss patent No. 74124. Eggs are preserved by impregnating the shell with a liquid containing at least one drying oil and allowing the latter to dry and form a film.—Chem. Abstr. 1917, v. 11, p. 1866.

OXYGENIUM.

Adamson, Tilden: Compressed oxygen used for the production of the oxyacetylene flame for welding purposes is above the U. S. P., IX, standard for purity, and may be used for medicinal purposes. It is 98 per cent pure, whereas the U. S. P. requires "not less than 95 per cent."—J. Am. M. Assoc. 1917, v. 68, p. 1621–1622.

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Fercocq, F.: A simple method for the preparation of pure oxygen makes use of the reaction which takes place between a solution of hydrogen peroxide and potassium permanganate, alone or in the presence of sulphuric acid.—Schweiz. Apoth.-Ztg. 1916, v. 54, p. 190–191.

A. Vo.: A review of a volume by Martin (and seven joint authors) on industrial gases. The work includes descriptions of the methods of manufacturing and liquefying hydrogen, oxygen, nitrogen, ammonia, sulphur dioxide, carbon dioxide, etc.—Chem. Weekbl. 1917, v. 14, p. 174.

Haldane, J. S.: A discussion of the methods of administering oxygen and the benefits derived therefrom.—Brit. M. J. 1917, v. 1, p. 181–183.

Nicloux, M.: A report of experiments showing the importance of oxygen in the treatment of carbon monoxide poisoning.—Presse médicale, 1917, v. 25, p. 153; J. Am. M. Assoc. 1917, v. 68, p. 1511.

PANCREATINUM.

Dohme, A. R. L.: The committee on standards and deterioration of the American Drug Manufacturers' Association finds it desirable to determine whether or not the milk test for pancreatin be retained in the U. S. P., as it seems unreliable and unnecessary.—Proc. Am. Drug Mfg. Assoc. 1917, p. 184.

Rakuzin, M. A., and Pekarskaya, G. F.: A preliminary communication on researches dealing with the optical and other properties of pancreatin.—J. Russ. Phys. Chem. Soc. 1916, v. 48, p. 1314–1315, through J. Chem. Soc. Lond. 1917, v. 112, part 1, p. 422.

Long, J. H., and Hull, Mary: A report of further researches to determine the effect of pepsin and acid on trypsin.—J. Am. Chem. Soc. 1917, v. 39, p. 162–174, 1493–1500.

PARACOTO, N. F.

Anon.: Of six samples of paracoto bark examined not one agreed with the description given in the N. F.—Proc. N. W. D. A. 1917, p. 519.

PARAFFINUM.

Fleissig: A review of methods for the determination of melting points, with special reference to the melting point of paraffin.—Schweiz. Apoth.-Ztg. 1917, v. 55, p. 2–4.

Nienstadt, A. E.: U. S. patent No. 1239618. A paraffin powder is prepared by melting paraffin and stirring it with a solution of ammonium stearate in water or other solvent until cool.—Chem. Abstr. 1917, v. 11, p. 3454.

Marcusson, J.: A continuation of previous work relating to the detection and determination of paraffin.—Chem. Zentralbl. 1916, v. 1, p. 1285, through Chem. Abstr. 1917, v. 11, p. 1290.

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Wales, H. E.: A description of a method for the determination of paraffin in asphalt, oils, tarry materials, and paraffin base oils.—Chem. Analyst, 1917, v. 20, p. 12–13.

PARAFFIN FILMS (NONOFFICIAL).

Hull: Formulas for the preparation of paraffin dressings similar to that of ambrine are given.—Brit. M. J. 1917, v. 1, p. 37–38.

Anon.: A review of formulas for the preparation of paraffin films suitable for use in the treatment of burns.—Pharm. J. Lond. 1917, v. 98, p. 65.

Emerson, M. L.: A report of experiences with the wax-paraffin film in the treatment of burns.—J. Am. M. Assoc. 1917, v. 69, p. 274–275.

Kirmission: A description of the treatment of burns by means of ambrine, a mixture of paraffin and resin. An abstract.—Practitioner, 1917, v. 98, p. 91.

Rathery and Bauzil: A formula for the preparation of a paraffin dressing analogous to ambrine is given.—J. des Practiciens, April 28, 1917, through Practitioner, 1917, v. 99, p. 190–191.

Sollmann, Torald: A report of experiments to devise a suitable formula for the preparation of a paraffin mixture similar to ambrine. Ordinary paraffin m. p. 50° C. was found to possess practically the same mechanical properties.—J. Am. M. Assoc. 1917, v. 68, p. 1037–1038.

Leech, P. N.: Notes on the composition of ambrine. A superior formula for its preparation is presented.—J. Am. M. Assoc. 1917, v. 67, p. 1497.

PAREIRA, N. F.

Dohme, A. R. L.: The stems of pareira or an allied plant are often used as a substitute or adulterant of the root which is official. They are readily distinguished by the greenish color of the bark or by adhering lichens, as well as by the larger pores of the wood, the concentric layers of which are generally disposed to separate one from another.—Proc. N. W. D. A. 1917, p. 512.

PASTÆ.

Colledge, L., and Drummond, Hamilton: A report on the treatment of recent gunshot wounds with bismuth-iodoform paste.—Lancet, 1917, v. 193, p. 49–51.

PASTA ZINCI, N. F.

Anon.: In commenting on the N. F. method for preparing zinc paste it is stated that warming the mortar in which the preparation is to be made and melting that portion of the petrolatum which is first mixed with the zinc oxide is advantageous, in that it yields a very smooth mixture free from grittiness.—N. A. R. D. J. 1917, v. 24, p. 405.

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PELLETIERINÆ TANNAS.

Tanret, Ch.: Exception is taken to the replacing of the name pelletierine in the four alkaloids of pomegranate bark by the term "punicine." The latter was applied by Righini to oleoresinous matter extracted by him from the pomegranate tree, while methyl-, iso-, and pseudo-pelletierine are the names which were originally given these alkaloids by Tanret.—J. pharm. et chim. 1917, v. 15, p. 158–159.

Anon: A study of the pharmacological action of pelletierine. In warm-blooded animals pelletierine produces an excitation of the nervous system which is obscured by the simultaneous development of a progressive muscular paralysis. The anthelmintic action of pelletierine is explained by the paralysis which it produces.—J. suisse pharm. Aug. 31, 1916, through Répert. pharm. 1917, v. 28, part 2, p. 8–9.

PEPSINUM.

Ramsay, C. F.: A series of tests made by the author indicates that pepsin solutions deteriorate and that the deterioration is progressive. That acidity is a feature promoting deterioration is shown by the greater loss in activity of the preparations containing the larger percentage of acid.—J. Am. Pharm. Assoc. 1917, v. 6, p. 1047–1048.

Scoville, Wilbur L.: The N. F., IV, contains 12 different liquid preparations of pepsin, none of which have been very closely studied for therapeutic permanency. We really know but little about the value of official pepsin preparations after they are a few months old.—Am. Druggist, 1917, v. 65, No. 1, p. 26.

Congdon, Leon A.: Of 87 samples of pepsin preparations examined between 1905 and 1917, 29 were passed and 58 were below standard. The percentages would be 33.33 per cent legal and 66.67 per cent illegal.—Proc. Kansas Pharm. Assoc. 1917, p. 87.

Graber, Howard T.: A report of investigations dealing with the rennetic properties of pepsin.—J. Ind. & Eng. Chem. 1917, v. 9, p. 1125–1126.

PERSIO, N. F.

Farwell, Oliver Atkins: "(*Fam. Parmeliaceæ*)" should be inserted after "lichens."—Drug. Circ. 1917, v. 61, p. 231.

Engelhardt, H.: The scarcity of cudbear at the present time has apparently induced some dealers to put a drug on the market which is far inferior in coloring power. The color produced by some of the recent shipments of the drug has a decidedly yellowish-red tint instead of the characteristic dark bluish-red color.—J. Am. Pharm. Assoc. 1917, v. 6, p. 409.

Roberts, J. G.: A sample of cudbear offered by a broker was considered unfit on account of having a low color value and because of its gummy conditions and sour odor.—Proc. Pennsylvania Pharm. 1917, p. 84.

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PETROLATUM.

Lami, Pio: A paper dealing with vaseline and its use in pharmacy.—Boll. chim.-farm. 1917, v. 56, p. 65–69.

Gifford, N.: Ordinary soft paraffin is considered to be preferable to liquid paraffin and more efficacious for the relief of chronic constipation.—J. Am. M. Assoc. 1917, v. 68, p. 304.

PETROLATUM LIQUIDUM.

Anon.: A list of 35 trade names under which liquid paraffin is sold.—Am. Druggist, 1917, v. 85, No. 11, p. 42.

Engelhardt, H.: From an examination of the liquid petrolatums on the market the author concludes that, with the exception of the California heavy liquid petrolatum, no other liquid petrolatum, even that of Russian origin, meets the sulphuric-nitric acid test as proposed for adoption by the U. S. P., IX.—J. Am. Pharm. Assoc. 1917, v. 6, p. 412.

Odom, W. F., and Davies, W. W.: From an experimental comparison of American and Russian mineral oils the authors conclude that a liquid paraffin, which has undergone extensive clinical investigation, is free from olefeines or other active substances, and which is of high viscosity, should serve as the best medicinal lubricant for intestinal stasis.—J. Am. Pharm. Assoc. 1917, v. 6, p. 257–259.

Francis, C. K., and Crawford, C. W.: An investigation relative to the detection and determination of sulphur in petroleum.—J. Ind. & Eng. Chem. 1917, v. 9, 479–481.

Anon.: Fluorescense in liquid petrolatum can be made to disappear by the addition of a small amount of nitronaphthaline; 0.2 to 0.3 gm. per 100 cubic centimeters is sufficient for this purpose.—Pharm. Ztg. 1916, v. 61, p. 208, through Schweiz. Apoth.-Ztg. 1916, v. 54, p. 218.

Patch, E. L.: The specific gravity of eight samples of liquid petrolatum examined ranged from 0.850 to 0.858 at 25° C. Two of the samples showed fluorescence; six showed a marked darkening when heated with sulphuric acid.—J. Am. Pharm. Assoc. 1917, v. 6, p. 412.

Roberts, J. G.: All lots of liquid petrolatum examined complied with the viscosity tests and other requirements of the U. S. P.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 89.

Scoville, W. L.: Much of the liquid petrolatum on the market has a kerosene odor and taste, and darkens when heated with sulphuric acid.—J. Am. Pharm. Assoc. 1917, v. 6, p. 412.

Stern, Heinrich: Notes on the use of liquid petrolatum in the treatment of gastric affections.—Am. Med. 1917, v. 23, p. 561–562.

Burns, Nesbitt: Insufficiently purified liquid paraffin causes a skin eruption of a pseudo-erysipelas type when used for the dressing of wounds.—Chem. & Drug. 1917, v. 89, p. 1039.

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Salomon, O.: Three cases of poisoning are reported due to the use of liquid petrolatum instead of olive oil for diluting ointments. An abstract.—Pharm. Weekbl. 1917, v. 54, p. 1361.

PETROSELINUM.

Farwell, Oliver Atkins: *Petroselinum hortense* Hoffmann has precedence over *Petroselinum sativum* Hoffmann, but the valid binomial is *Petroselinum Petroselinum* (Linné.) Karsten.—Drug. Circ. 1917, v. 61, p. 175.

Engelhardt, H.: Eight lots of parsley seed examined yielded from 11 to 29 per cent of oleoresin.—J. Am. Pharm. Assoc. 1917, v. 6, p. 413.

PETROXOLINUM IODI, N. F.

Anon.: Any turbidity in this preparation is due to the use of inferior ingredients. The oleic acid and stronger ammonia water must be of U. S. P. standard, otherwise an unsatisfactory product is sure to result.—N. A. R. D. J. 1917, v. 24, p. 1058.

PETROXOLINUM LIQUIDUM, N. F.

Beringer, George M.: Liquid petrox of the N. F., IV, is an ammonia soap solution of light mineral oil. It is used as a readily absorbable vehicle for medicines applied externally to produce a desired action on subdermal tissues. Proc. New Jersey Pharm. Assoc. 1917, p. 92.

Anon.: Since Russian liquid petrolatum is no longer obtainable, American oils must be used in the manufacture of this preparation, and the best way to obtain a satisfactory product is to use spirit of ammonia instead of stronger ammonia water and alcohol, as directed by the N. F.—N. A. R. D. J. 1917, v. 23, p. 584.

PHENOL.

Scoville, W. L.: Phenol of high grade is scarce. Most of that offered is dark in color, has a foreign odor, and a low melting point.—J. Am. Pharm. Assoc. 1917, v. 6, p. 413.

Aylsworth, J. W., et al.: U. S. patent No. 1213142. A method for preparing phenol by heating a mixture of chlorobenzene and alkali hydroxide solution at 300° and under a pressure higher than that of the vapor tension of the mixture is described.—J. Soc. Chem. Ind. 1917, v. 36, p. 382.

Asher, Philip: An explanation of the U. S. P. method for the assay of phenols.—Am. J. Pharm. 1917, v. 89, p. 167–168.

Krak, J. B.: Methods for the determination of phenol and salicylic acid in antiseptic gauzes and cotton are described.—Year-Book of Pharmacy, 1917, p. 257.

Weiss and Downs: A detailed description of a method for the determination of phenol in crude carbolic acid and tar oils.—J. Ind. & Eng. Chem. 1917, v. 9, p. 569.

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Congdon, Leon A.: Of 48 samples of carbolic acid examined between 1905 and 1917, 21 were passed, 26 were below standard, and 1 above standard. This would mean 43.75 per cent legal and 56.25 per cent illegal.—Proc. Kansas Pharm. Assoc. 1917, p. 87.

Sayre et al.: Four of five samples of carbolic acid were below standard or adulterated.—Rep. Kansas Bd. Health, 1916, v. 12, p. 428.

PHENOL LIQUEFACTUM.

McElhenie, T. D.: A description of a safe and easy method for the preparation of liquid phenol. An abstract.—Bull. Pharm. 1917, v. 31, p. 123.

Sayre et al.: Nine of 20 samples of liquefied phenol examined were low in phenol content.—Rep. Kansas Bd. Health, 1917, v. 13, p. 170.

PHENOLPHTHALEINUM.

Dohme, A. R. L.: Some samples of phenolphthalein are very dark in color, low in melting point, and contain impurities which are decidedly objectionable. A good product is not easily obtained.—Proc. N. W. D. A. 1917, p. 511.

Green, C.: One lot of phenolphthalein examined was dark in color and melted at about 210° C. The U. S. P. requires a melting point not below 253° C.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 89.

PHENYLIS SALICYLAS.

Miller, R.: A method for the determination of salol and quinine in tablets is described in detail.—Am. J. Pharm. 1917, v. 89, p. 215.

Nacken, R.: Experiments with salol in determining the velocity of crystallization in undercooled fusions are described.—Centr. Min. Geol. 1917, p. 191–203, through J. Chem. Soc. Lond. 1917, v. 112, part 2, p. 363.

Roberts, J. G.: One lot of phenyl salicylate examined was rejected on account of its undesirable dark color.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 89.

Todd, A. R.: One sample of salol examined was rejected for being of poor quality.—Bull. Michigan D. & F. Dept. 1917, No. 264–267, p. 24.

PHOSPHORUS.

Terwen, J. W.: A review of the progress made in the chemistry of phosphorus during the last 15 years, with a summary of the literature. Four allotropic forms of phosphorus are mentioned—namely, violet, white isometric, white hexagonal, and black.—Chem. Weekbl. 1917, v. 14, p. 180–197.

Lemkes, H. J.: A report of researches on the determination of phosphorus by the Dusart-Blondlot method and the application of the method to toxicological work.—Farm. Españ. 1917, v. 49, p. 518–520, 535–537, 550–552.

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Burge, W. E.: A report of the effect of phosphorus poisoning on the catalase content of the tissues.—Am. J. Phys. 1917, v. 43, p. 545–548.

PHYSOSTIGMA.

Anon.: The ether-soluble alkaloidal content of one sample of Calabar bean assayed was above standard.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 92.

Polonovski, Max: A report of further studies on the alkaloids of Calabar bean.—Bull. soc. chim. France, 1917, v. 21, p. 191–200 335–361.

PHYSOSTIGMINÆ SALICYLAS.

Nourse, A. L.: A study of the physiological action and therapeutic applications of physostigmine.—Am. J. Clin. Med. 1917, v. 24, p. 717–719.

PHYTOLACCA, N. F.

Farwell, Oliver Atkins: The proper valid designation of the source of poke root is *Phytolacca Americana* Linné.—Drug. Circ. 1917, v. 61, p. 231.

PILOCARPINÆ HYDROCHLORIDUM.

Roberts, J. G.: A recent importation of pilocarpine hydrochloride examined was of U. S. P. quality except that it had a melting point of 198.5° C. to 199.5° C., which is a little above the U. S. P. standard of 195° C. to 198° C. A sample of pilocarpine hydrochloride put out by a reliable and well-known manufacturer had a melting point ranging from 198.75° C. to 199.5° C. It was considered of good quality, as the melting point method of the U. S. P. IX has a tendency to give results slightly higher than the U. S. P. standard for pilocarpine hydrochloride.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 89.

Ransom, Fred: A study of certain antagonists of pilocarpine.—J. Pharmacol. & Exper. Therap. 1917, v. 10, p. 169–184.

PILOCARPUS.

Anon.: The alkaloidal content of one sample of pilocarpus assayed was above standard.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 92.

PILULÆ.

Maske, William J.: Notes on the use of manna in the preparation of soft mass pills.—J. Am. Pharm. Assoc. 1917, v. 6, p. 1058–1059.

Grönberg: An account of trituration experiments with various substances to obtain data relative to the distribution of materials in pills and divided powders.—Farm. Rev. 1916, No. 52, through Schweiz. Apoth.-Ztg. 1917, v. 55, p. 88.

Richardon: A discussion of methods for the preparation of pills containing hypophosphites. An abstract.—Giorn. farm. chim. 1917 v. 66, p. 108.

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Maske, William, jr.: A presentation of data showing the rate of disintegration of various pill masses.—J. Am. Pharm. Assoc. 1917, v. 6, p. 1059–1062.

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Anon.: A sample of ground pepper examined in England was found to be adulterated with 4.5 per cent of sodium chloride.—Brit. Food J. 1917, v. 19, p. 215.

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Torossian, G.: Dilute nitric acid (1:5) containing 0.5 per cent of tartaric acid is stated to be an excellent solvent for red lead.—J. Ind. & Eng. Chem. 1916, v. 8, p. 1076.

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Anon.: Experiments conducted in the H. K. Mulford laboratories indicate that the U. S. P., VIII, method for assaying mandrake gives better results, and is therefore superior to the method given in the U. S. P., IX. Analytical data to this effect are presented.—Drug. Circ. 1917, v. 61, No. 10, p. 29.

Anon.: The resin content of one sample of mandrake assayed was above standard.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 92.

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Van der Haar, A. W.: An English sample of potassium acetate examined contained chloride and sulphate.—Pharm. Weekbl. 1917, v. 54, p. 256.

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Anon.: A sample of cream of tartar examined in England was found to contain 50 parts per million of lead.—Brit. Food J. 1917, v. 19, p. 54.

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Schabelitz, H.: An experimental study of bromism, including observations made by the author upon himself.—Chem. Abstr. 1917, v. 11, p. 500.

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Dohme, A. R. L.: One lot of potassium carbonate examined contained 20.6 per cent excess of water, and was 2.1 per cent low in strength after drying.—Proc. N. W. D. A. 1917, p. 515.

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Dohme, A. R. L.: One lot of potassium ferrocyanide examined was of unsatisfactory quality and showed that it was alkaline in reaction, contained sulphate and chloride, and an excess of water. It also had an indicated strength of 102.61 per cent when tested according to the permanganate method.—Proc. N. W. D. A. 1917, p. 515.

Roberts, J. G.: Recent shipments of potassium ferrocyanide have been too alkaline and have contained excessive amounts of sulphate and water. They were greenish-yellow instead of a lemon-yellow color, and had an indicated strength as high as 107.8 per cent when tested according to the permanganate method.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 90.

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Hommell, P. E.: This preparation does not contain sufficient antidotal properties to prevent death in diseased or susceptible individuals. Headache remedies in most cases should be given in fluid form, with enough heart stimulant to prevent death.—Proc. New Jersey Pharm. Assoc. 1917, p. 84.

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Hommell, P. E.: The present compound chalk powder should be removed from the U. S. P., as the presence of sugar in the formula positively defeats the object for which it is intended.—Proc. New Jersey Pharm. Assoc. 1917, p. 82.

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Rippetoe, J. R.: The U. S. P. should give an ash standard for compound licorice powder.—Drug. Circ. 1917, v. 61, p. 502; J. Am. Pharm. Assoc. 1917, v. 6, p. 464.

Editorial: Owing to the shortage of sugar in England it is suggested that the same be replaced in compound licorice powder, Ph. Brit., by the addition of more of the powdered licorice.—Chem. & Drug. 1917, v. 89, No. 1961, p. 43.

PULVIS IPECACUANHÆ ET OPII.

Asher, Philip: A method for the assay of Dover's powder should be included in the U. S. P.—Am. J. Pharm. 1917, v. 89, p. 175.

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Anon.: The reddening of salicylic acid dusting powder is stated to be due to the iron content of the talc. To prevent this, dry the powders thoroughly before mixing.—Schweiz. Apoth.-Ztg. 1917, v. 55, p. 420.

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Van der Marck, J. I. B.: Instead of the quantities recommended in the Ph. Nedl., the author recommends using a mixture containing 16 per cent of nitric acid, 65 per cent of sulphuric acid, and 19 per cent of water for the nitration of the cotton in the preparation of pyroxylin.—Pharm. Weekbl. 1917, v. 54, p. 53–57.

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Rogers, Sir Leonard: An experimental investigation of the suitability of the more soluble salts of quinine and cinchona for intravenous injection.—Brit. M. J. 1917, v. 2, p. 381–384.

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White, E. C.: The milk-coagulating power of seven lots of rennin examined ranged from 1 in 20,450 to 1 in 114,000 on a 7½-minute basis.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 90.

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RESINA JALAPÆ.

Dohme, A. R. L.: Variable results are obtained in the assay of jalap as an appreciable amount of the chloroform-soluble material is retained by the filter, the amount retained depending on the size of the filter. It is recommended that the filter be washed with chloroform until all soluble matter is removed. The same criticism applies to the determination of the solubility of the resin in ether. Proc. N. W. D. A. 1917, p. 503.

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RESINA PODOPHYLLI.

Scoville, Wilbur L.: Under resin of podophyllum, U. S. P., the resin of *Podophyllum emodi* is distinctly outlawed. The latter species is now recognized by the British Pharmacopœia, and recent work upon it indicates that it is superior to the species recognized by the United States Pharmacopœia.—Am. Druggist, 1917, v. 65, No. 1, p. 26.

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Wolff, J.: A description of a biochemical reaction for differentiating pyrocatechol, hydroquinone, and resorcinol. The method is based on the different color reactions which take place when a maceration of *Russula delica* (or other fungus rich in laccase) is added to these diphenols.—J. pharm. et chim. 1917, v. 15, p. 94; Ann. chim. analyt. 1917, v. 22, p. 105; Pharm. J. 1917, v. 98, p. 139.

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Nelson, E. K.: A method for the quantitative determination of santonin in Levant wormseed is described. The method is a modification of the Katz-Fromme procedure. Analytical data obtained with the use of this method are presented.—J. Assoc. Off. Agric. Chem. 1916, v. 2, p. 79–82.

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Marcusson, J., and von Huber, H.: Notes on the detection of marine animal oils in fats and soaps. An abstract.—J. Soc. Chem. Ind. 1916, v. 35, p. 1121.

Rippetoe, J. R.: The U. S. P. method of separating the fatty acids for determining their iodine number is a very tedious process. Acidifying the aqueous solution, extracting with ether, washing the ether solution with water, and evaporating at a low heat is much more expedient and practical. The acids may be dried in a vacuum dessicator or over sulphuric acid and weighed before determing the iodine number.—Drug. Circ. 1917, v. 61, p. 502; J. Am. Pharm. Assoc. 1917, v. 6, p. 464.

Thieme, C.: A method for the determination of fatty acids in war soaps is described.—Seifenfabrikant, 1916, v. 36, p. 739 through Chem. Abstr. 1917, v. 11, p. 1326.

Cormack, J. A.; A new process for the estimation of unsaponifiable matter in soap is described.—Chem. Analyst, 1917, v. 21, p. 14.

Izmailski, V. A.: From experiments it is concluded that neither the alcohol method nor the barium chloride method give accurate results in the determination of the free alkali hydroxide in soap. A more satisfactory method is described by the author.—J. Russ. Phys. Chem. Soc. 1916, v. 48, p. 411–432, through J. Chem. Soc. Lond. 1917, v. 112, part 2, p. 153.

Besson, A. A.: A description of a distillation method for the determination of moisture in soap and cheese.—Schweiz. Apoth.-Ztg. 1917, v. 55, p. 69–71.

Ratynski: A 20 per cent solution of white castile soap in warm water is recommended for use as a dressing for wounds.—Compt. rend. acad. sc. 1917, v. 164, p. 199.

SAPO MOLLIS.

Beringer, George M.: The change made in the U. S. P. formula for soft soap, cottonseed oil being directed in place of linseed oil, has been actuated by economic, rather than scientific, reasons. The

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new formula is defective and the product is deficient in detergent properties.—Am. J. Pharm. 1917, v. 89, p. 352.

Roller, Emil: The U. S. P. should direct that 90 grams instead of 86 grams of potassium hydroxide be used in the preparation of soft soap, because the KOH content of the alkali is usually less than 85 per cent. It is also stated that the alkali should be dissolved in 400 mils of water, instead of 100 mils as directed.—D.-A. Apoth.-Ztg. 1917, v. 38, p. 30.

Robinson Bros. and Swithenbank: British patent No. 104,409 describes the making of soft soaps from sulphonated sardine, or other fish oil, and sodium hydroxide.—Chem. Abstr. 1917, v. 11, p. 1915.

Rippetoe, J. R.: It is desirable that the U. S. P. direct that the fatty acids and their iodine number be determined for soft soap.—Drug. Circ. 1917, v. 61, p. 502; J. Am. Pharm. Assoc. 1917, v. 6, p. 465.

Wondrath, R.: A war formula for the preparation of potash soap makes use of oleic acid instead of an oil.—Apoth. Ztg., through Pharm. Post, 1917, v. 50, p. 197.

Dohme, A. R. L.: One sample of soft soap was not entirely of U. S. P. quality, as it contained 1.65 per cent excess of water, only 0.03 per cent free alkali, and was not sufficiently soluble in 20 parts of hot water.—Proc. N. W. D. A. 1917, p. 515.

Roberts, J. G.: Two lots of soft soap, made according to the U. S. P., IX, method, were rejected because they contained an excess of water and no free alkali. One of the lots gave a turbid solution with water, indicating the presence of uncombined fat. The other shipment consisted of four barrels, the contents of which differed in consistency and color.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 90.

SARSAPARILLA.

Dohme, A. R. L.: One lot of very inferior drug, which had a decidedly dead appearance, and was almost black in color, was offered as Mexican sarsaparilla.—Proc. N. W. D. A. 1917, p. 520.

SASSAFRAS.

Farwell, Oliver Atkins: *Sassafras Sassafras* (Linné) Karsten is the proper combination for the official sassafras.—Drug. Circ. 1917, v. 61, p. 175.

SCAMMONIÆ RADIX.

Dohme, A. R. L.: Mexican scammony root, *Ipomaea Orizabensis* (pell.) Ledan., has been used as a substitute for both the Levant scammony, *Convolvulus Scammonia*, Lin. and the jalap, *Exogonium Purga* (Wendr.) Benth. It is usually cut in cross sections and is rough from the protruding wood fiber arranged in concentric circles. It has the appearance of poke root.—Proc. N. W. D. A. 1917, p. 512.

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Anon.: The committee on standards and deterioration of the American Drug Manufacturers' Association finds it desirable to determine whether or not Mexican scammony (*Ipomoea Orizabensis*) is not as efficient and desirable as the oriental drug, true scammony being increasingly scarce.—Am. Drug. Mfg. Assoc. 1917, p. 185.

Dohme, A. R. L.: One lot of scammony (Mexican) contained 13.26 per cent resin.—Proc. N. W. D. A. 1917, p. 515.

SCILLA.

Colson, H. C., jr., and Engelhardt, H.: A discussion of experiments conducted for the purpose of determining if the U. S. P., IX, biological standard for squill is correct.—J. Am. Pharm. Assoc. 1917, v. 6, p. 950.

SCOPARIUS, N. F.

Farwell, Oliver Atkins: The specific name in *Cytisus Scoparius* (Linné) Linké should be decapitalized. It is not a generic or a vernacular name; just an adjective.—Drug. Circ. 1917, v. 61, p. 175.

SCOPOLA.

Roberts, J. G.: One lot of scopola root examined contained 9 per cent of moisture and 0.33 per cent of alkaloids. The lot was not fully dried and did not comply with the requirements of the U. S. P. VIII, as guaranteed when purchased.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 91.

Anon.: The alkaloidal content of one sample of scopola assayed was below standard.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 92.

SCOPOLAMINÆ HYDROBROMIDUM.

Straub: The addition of a polyatomic alcohol is recommended as a means of rendering solutions of scopolamine stable. Mannitol is the alcohol recommended for use.—Boll. chim. farm. 1917, v. 56, p. 170.

Bolten, H.: A note on injurious effects produced by the use of old solutions of scopolamine hydrobromide. Alkali-free glass containers do not prevent deterioration.—Ned. Tijdschrift Geneeskunde, 1917, p. 1466, through Pharm. Weekbl. 1917, v. 54, p. 456.

Schmidt, E.: A report of researches to determine the constitution of scopoline.—J. Chem. Soc. Lond. 1917, v. 112, part 1, p. 409.

Greenwood, W. O.: A report of the results of scopolamine-morphine treatment during labor in 150 consecutive cases.—Brit. M. J., 1917, v. 1, p. 355–357.

SCUTELLARIA, N. F.

Dohme, A. R. L.: Of nine samples of scutellaria examined only two proved to be of the official variety. *Scutellaria incana* and

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Scutellaria galericulata were the species most commonly offered for the true drug. One lot of skullcap examined contained at least 15 per cent of foreign leaves and fruits.—Proc. N. W. D. A. 1917, p. 515 and 520.

SENNA.

Memminger, Lucien: An account of the senna industry of Tinnevelly.—Com. Rep. 1917, No. 213, p. 975.

Southard, Addison E.: A consular report on the exportation of senna leaves from Aden to the United States for the second quarter of the year 1917.—Com. Rep. 1917, No. 198, p. 728–729.

Dohme, A. R. L.: The U. S. P. permits the use of the leaflets of *Cassia acutifolia* Delile (Alexandria senna), and of *Casia angustifolia*, Vahl. (Tinnevelly or Indian senna). As the Tinnevelly or Indian senna is a cultivated product, the leaflets gathered from the wild plant (Arabian or Mecca senna) are not admissible under the U. S. P. definition. They are gathered in large quantities, however, and are used as an adulterant of, or substitute for, Alexandria senna. —Proc. N. W. D. A. 1917, p. 512.

Alsberg, C. L.: Examination of samples of importations of "senna" leaves by the Bureau of Chemistry has shown that the material sometimes contains considerable amounts of *Tephrosea apollinea*. The latter contains a toxic glucoside, tephrosin.—S. R. A.-Chem. 1917, No. 19, p. 52.

Engelhardt, H.: A brief note concerning German substitutes for senna leaves.—J. Am. Pharm. Assoc. 1917, v. 6, p. 59.

Kraemer, Henry: Comments on the use of coriaria as an adulterant of senna and marjoram. Illustrations showing the distinguishing histological characters are given.—Pacific Pharm. 1917, v. 11, p. 13–15.

Joenssen, A.: A note calls attention to the fact that broken leaflets of "Arabian" senna (*Cassia angustifolia* Vahl.) and "dog" senna (*Cassia obovata* Collad.) have recently been used to adulterate "Alexandrian" senna. Data showing the amounts of free and combined hydroxymethyl-anthraquinones in Alexandrian senna are given.—Chem. & Drug. 1917, v. 89, p. 47.

Dohme, A. R. L.: Several samples of Alexandrian senna (siftings) were found to be adulterated with both Indian senna and sand.—Proc. N. W. D. A. 1917, p. 520.

Casparis: Comments on the Bornträger test of the Ph. Helv. for senna leaves. The author points out that *Cassia auriculata* L., a substitute appearing in Austria and Switzerland, also gives the Bornträger color test.—Schweiz. Apoth.-Ztg. 1917, v. 55, p. 97–99.

Beal, George D., and Okey, Ruth: A description of a method for the qualitative identification of the drugs containing emodin.—J. Am. Chem. Soc. 1917, v. 39, p. 716–725.

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Sayre et al.: A sample of senna leaves examined was found to be worm-eaten.—Rep. Kansas Bd. Health, 1916, v. 12, p. 430.

SERUM ANTIDIPHTHERICUM.

Crawford, Albert C., and Andrus, Carlton L.: A report of some experiments on the chemical reactions of diphtheria antitoxin.—Am. J. Pharm. 1917, v. 89, p. 158–165.

Stewart, F. E.: An account of the preparation of diphtheria antitoxin.—Pharm. Era, 1917, v. 50, p. 9–10.

Hitchens, A. P., and Tingley, E. K.: A description of an intrapalpebral toxin test for the selection of horses for the production of diphtheria antitoxin.—J. Immunol, 1917, v. 2, p. 395–397; J. Am. M. Assoc. 1917, v. 68, p. 1660.

Stewart, F. E.: A discussion of the importance of diphtheria antitoxin and of the dosage of the same.—Pharm. Era, 1917, v. 50, p. 119–120.

SERUM ANTIDIPHTHERICUM PURIFICATUM.

Stewart, F. E.: A description of the Gibson process for the preparation of purified diphtheria antitoxin.—Pharm. Era, 1917, v. 50, p. 10–11.

SERUM ANTITETANICUM.

Stewart, F. E.: A short historical account of the discovery of tetanus antitoxin, together with remarks on the precautions which should be observed in its administration.—Pharm. Era, 1917, v. 50, p. 120.

MacConkey, A. T., and Homer, Annie: Experiments are described showing the passive immunity conferred by a phrophylactic dose of antitetanic serum.—Lancet, 1917, v. 1, p. 259–261.

Bruce, D.: A report of experiments to determine whether administration of tetanus antitoxin by the intramuscular or intrathecal route gives the best results.—Lancet, 1917, v. 1, p. 680–682; see also F. Golla, Ibid. p. 686.

SEVUM PRÆPARATUM.

Issoglio, Giovanni: Data showing the oxidizability number of samples of fresh and rancid mutton tallow are presented.—Giorn. farm. chim. 1917, v. 66, p. 249.

SINAPIS ALBA.

Alsberg, C. L.: Standards for mustard seed are given, and an assay method for the determination of the volatile oil is described.—S. R. A.-Chem. 1917, No. 20, p. 58–59.

Rusby, H. H.: Supplies of genuine mustard of good quality have been so scanty that the export of thousands of tons of related seeds

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from India and China has been stimulated. The variety has been bewildering, and it has been found utterly impossible to identify the different individuals. Some have a certain amount of pungency while others have none.—J. Am. Pharm. Assoc. 1917, v. 6, p. 411.

Frazer, Robert, jr.: An account of the Japanese trade in mustard seed, giving statistics showing the amount produced and exported for the years 1915 and 1916.—Com. Rep. 1917, No. 197, p. 712–713.

Anon.: Notice of judgment No. 4798 relates to the adulteration of mustard seed.—S. R. A., Chem. 1917, p. 371.

SODII ACETAS.

van der Haar, A. W.: Samples of sodium acetate examined contained traces of chlorides and heavy metals.—Pharm. Weekbl. 1917, v. 54, p. 256.

SODII ARSENAS.

Schreinemakers, I. F. A. H., and de Baat, W. C.: Researches on the composition of the sodium arsenates. A study of the system H_2O–As_2O_3–Na_2O at 25° C.—Chem. Weekbl. 1917, v. 14, p. 262–267.

Asher, Philip: An explanation of the chemistry of the U. S. P. method for the assay of sodium arsenate.—Am. J. Pharm. 1917, v. 89, p. 168.

Lovett, A. L., and Robinson, R. H.: A report of experiments to determine the toxic value and killing efficiency of the arsenates for caterpillars.—J. Agric. Res. 1917, v. 10, p. 199–207.

SODII BENZOAS.

Smith, Carl E.: It is recommended that the Pharmacopœia should prescribe a direct method for the determination of benzoic acid in sodium benzoate in order to limit the amount of water contained in the salt and to eliminate the possibility of the adulteration of the same with sodium salts of cheaper organic acids. These points are not covered by the present pharmacopœial tests for the salt.—Am. J. Pharm. 1917, v. 89, p. 576–577.

Roberts, J. G.: One lot of sodium benzoate examined was adulterated with boric acid. Six of 11 other lots examined were low in strength and gave results ranging from 97.34 per cent to 98.95 per cent.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 91.

SODII BICARBONAS.

Kolthoff, I. M.: A discussion of methods for the determination of carbonate in bicarbonate. It is stated that titration with phenolphthalein as directed in the Ph. Nedl. is sensitive to only 2 per cent.—Pharm. Weekbl. 1917, v. 54, p. 1046–1051.

Canals, E.: A report of an investigation dealing with the action of sodium bicarbonate on certain salts used in pharmacy. The experi-

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ments supplement those of Astruc and Cambe.—J. pharm. et chim. 1917, v. 15, p. 145–149.

Hegnel: Some observations on incompatible mixtures, with special reference to sodium bicarbonate in irrational prescriptions.—Boll. chim.-farm. 1917, v. 56, p. 280.

SODII BORAS.

Anon.: A note on the sources of borax in the United States.—Oil, Paint & Drug Rep. 1917, v. 91, No. 11, p. 57.

SODII CACODYLAS.

Dohme, A. R. L.: One shipment of sodium cacodylate examined gave a strong odor of cacodyl and was rejected.—Proc. N. W. D. A. 1917, p. 507.

McCaffrey, J. C.: One lot of sodium cacodylate examined contained a slight trace of trivalent arsenic.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 90.

SODII CARBONAS MONOHYDRATUS.

Seyler, Clarence, and Lloyd, Percy V.: A study of the hydrolysis of sodium carbonate and bicarbonate, and the ionization constants of carbonic acid.—J. Chem. Soc. Lond. 1917, v. 111, p. 138–158.

SODII CHLORIDUM.

Damman, L. W.: German patent No. 291265. Rock salt is converted into table salt by grinding to fine particles and moistening with an aqueous solution of another hygroscopic salt.—Chem. Abstr. 1917, v. 11, p. 876. See also p. 1271.

International Salt Co.: Holland patent No. 1601. Granulated sodium chloride is prepared by stirring the cooled solution and allowing it to flow over a series of superimposed fans.—Chem. Abstr. 1917, v. 11, p. 2029.

Long, E. T.: A study of the formation of salt crystals from hot saturated solutions.—Am. J. Sci. 1917, v. 43, p. 289–292.

Sill, H. F.: Data relative to the influence of pressure on the solubility of sodium chloride are presented.—J. Am. Chem. Soc. 1916, v. 38, p. 2632–2643.

Meredith, Mark: Salt as a wood preservative. Railroad sleepers impregnated with sodium chloride were in good condition after 43 years, whereas sleepers impregnated with zinc chloride had to be renewed after 14 years.—Machinery, 1917, v. 23, p. 586 through Chem. Abstr. 1917, v. 11, p. 1030.

SODII CITRAS.

Salant, William, and Wise, Lewis E.: Researches on the action of sodium citrate and its decomposition in the body.—J. Biol. Chem. 1917, v. 28, p. 27–58.

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SODII CYANIDUM.

Abegg, F.: U. S. patent No. 1232471. Hollow granules of sodium cyanide are made by spraying the molten cyanide against a metal plate exposed to the air. This form of cyanide is said to facilitate its solution in water.—Chem. Abstr. 1917, v. 11, p. 2395.

SODII GLYCEROPHOSPHAS.

Hegland, J. M. A.: A description of a method for the preparation of sodium glycerophosphate. The method consists in evaporating to dryness a mixture of $Na_4P_2O_7$ and H_3PO_4, adding glycerin, and heating at about 190° C.—Schweiz. Apoth.-Ztg. 1917, v. 55, p. 109–110.

SODII HYDROXIDUM.

Kipper, H. B.: U. S. patent No. 1227453. Solutions of sodium hydroxide are purified by electrolysing while heating at a temperature of 80 to 175° C., using a nickel anode and a steel cathode.—Chem. Abstr. 1917, v. 11, p. 2171.

Skossareswky, M., and Tchitchinadzé, N.: Data relative to the solubility of caustic soda in liquid ammonia are presented.—J. chim. phys. 1916, v. 14, p. 153–175.

SODII NITRAS.

Allen, A. W.: An account of the Chilean nitrate industry.—Eng. Mining, 1917, v. 103, p. 250–253, through Chem. Abstr. 1917, v. 11, p. 1020.

Monnier, A.: A report on the detection and determination of perchlorates in Chilean saltpeter by means of methylene blue.—Ann. chim. analyt. 1917, v. 22, p. 1.

SODII NITRIS.

Dohme, A. R. L.: The committee on standards and deterioration of the American Drug Manufacturers' Association finds it desirable to determine whether or not sodium nitrite tablets are liable to deteriorate.—Proc. Am. Drug. Mfg. Assoc. 1917, p. 185.

Sinigar, H.: A report of a fatal case of poisoning in an infant due to the ingestion of sodium nitrite.—Lancet, 1917, v. 193, p. 162.

SODII PERBORAS.

Rossi, Luis: A comprehensive article dealing with the preparation, properties, and analysis of perborates, with special reference to sodium perborate.—Rev. Farm. 1917, v. 60, p. 83–98.

Anon: British patent No. 100153. A method for the preparation of sodium perborate, by electrolysing a solution of sodium percarbonate and an alkaline borate, is described.—J. Soc. Chem. Ind. 1917, v. 36, p. 83.

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Asher, Philip: An explanation of the chemistry of the U. S. P., IX, method for the assay of sodium perborate.—Am. J. Pharm. 1917, v. 89, p. 170–171.

Dohme, A. R. L.: The committee on standards and deterioration of the American Drug Manufacturers' Association finds it desirable to determine the extent and rate of deterioration of perborates.—Proc. Am. Drug. Mfg. Assoc. 1917, p. 185.

SODII PHOSPHAS.

Smith, John H.: A paper dealing with the constitution of the alkali phosphates and some new double phosphates.—J. Soc. Chem. Ind. 1917, v. 36, p. 420–424.

Balareff, D.: Studies on the dehydration of sodium phosphate. Dehydration can be effected by heating to 250° C. ± 2°.—Ztschr. anorg. Chem. 1916, v. 97, p. 147–148, through J. Chem. Soc. Lond. 1917, v. 112, part 2, p. 88.

SODII PHOSPHAS EFFERVESCENS.

Rippetoe, J. R.: The U. S. P. should specify a test for sugar and assay methods for the quantitative determination of the sodium phosphate and sodium carbonate in this preparation. This comment also applies to other official effervescent salts.—Drug. Circ. 1917, v. 61, p. 502; J. Am. Pharm. Assoc. 1917, v. 6, p. 465.

SODII SALICYLAS.

Emery, W. O.: A description of a method for the estimation of acetanilid and sodium salicylate in mixtures.—J. Assoc. Off. Agric. Chem. 1916, v. 2, p. 70–71.

Miller, Reginald: A description of a method for the quantitative determination of sodium salicylate when admixed with acetylsalicylic acid.—Am. J. Pharm. 1917, v. 89, p. 347–348.

Yanovsky, V. L.: A discussion of the dosage of sodium salicylate. The proper dose is stated to be 2.5 to 5 grams in 24 hours. An abstract.—J. Am. M. Assoc. 1917, v. 68, p. 587.

Lecoq, R.: A note on the phenomenon of intolerance caused by the presence of salicylic acid in sodium salicylate. Sodium salicylate containing as little as 0.69 gram of salicylic acid per kilogram was not tolerated by infants or adults.—Bull. sci. pharmacol. 1917, v. 9, p. 287.

Fantus, Bernard, et al.: Researches to determine the effect of salicylates on experimental arthritis in rabbits.—Arch. Int. Med. 1917, v. 19, p. 529–537.

Gordon, W.: A report on the use of sodium salicylate in the treatment of trench foot.—Brit. M. J. 1917, v. 1, p. 121.

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Duncan, William: Notes on compounding a ferric chloride and sodium salicylate mixture.—Pharm. J. Lond. 1917, v. 98, p. 236 and 239.

Casey, F. W.: One sample of compressed tablets of sodium salicylate examined was rejected.—Bull. Michigan D. & F. Dept. 1917, No. 256–257, p. 16.

SODII SULPHAS.

Turkus, B.: An account of experiments dealing with the determination of potassium and sodium in sulphates by means of chloroplatinic acid.—Ann. chim. analyt. 1917, v. 22, p. 101–102.

SPARTEINÆ SULPHAS.

Tunmann, O.: The best reagents for the microchemical detection of sparteine are solutions of chromic acid (1–2 per cent); zinc chloride (1 per cent), cupric chloride (1 per cent), mercuric chloride, hydriodic acid, and potassio-cadmic bromide. The precipitates formed with these reagents assume characteristic crystalline forms.—Apoth.-Ztg. 1917, v. 32, p. 100–103, through J. Chem. Soc. Lond. 1917, v. 112, part 2, p. 518–519.

Valeur, Armand: The solubility of sparteine decreases as the temperature rises. The values of the temperature at which turbidity occurs for various dilutions of sparteine in the presence of 5 per cent aqueous sodium carbonate are given, and a method for the estimation of sparteine based on these data is described.—Compt. rend. Acad. sc. 1917, v. 164, p. 818–820.

SPIGELIA.

Rusby, H. H.: This drug, which a few years ago was very scarce, except in a highly adulterated form, is now quite abundant and of reliable quality, although adulterants and substitutes have still to be carefully looked for.—J. Am. Pharm. Assoc. 1917, v. 6, p. 413.

SPIRITUS.

Asher, Philip: The U. S. P. should prescribe methods for determining the volatile oil content of the various spirits.—Am. J. Pharm. 1917, v. 89, p. 175.

Hommell, P. E.: The alcohol in the U. S. P. and N. F. spirits should be replaced by deodorized alcohol or Cologne spirit, as this would tend to improve the odor and taste.—Proc. New Jersey Pharm. Assoc. 1917, p. 84.

SPIRITUS ÆTHERIS COMPOSITUS, N. F.

Barnard, H. E.: One sample of compound spirit of ether examined was rejected for being of poor quality.—Bull. Indiana Bd. Health, 1917, v. 20, p. 196.

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SPIRITUS ÆTHERIS NITROSI.

Dohme, A. R. L.: The committee on standards and deterioration of the American Drug Manufacturers' Association finds it desirable to determine the rate and extent of deterioration of spirit of nitrous ether.—Proc. Am. Drug Mfg. Assoc. 1917, p. 184.

Broeksmit, T. C. N.: For the preservation of spirit of ethyl nitrite it is recommended that neutralization be effected with magnesium carbonate and that the product be kept in a cool place. The shelf supply should be filtered off as needed and preserved by the addition of sodium sulphite. Free N_2O_3 can be detected by means of pyramidon.—Pharm. Weekbl. 1917, v. 54, p. 1051–1054.

Roller, Emil: The stability of spirit of nitrous ether is much greater if absolute alcohol is used in its preparation, instead of 95 per cent alcohol as directed in the U. S. P.—D.-A. Apoth.-Ztg. 1917, v. 38, p. 30.

Rippetoe, J. R.: The U. S. P. should direct that the spirit of nitrous ether be preserved in cork-stoppered bottles, as ethyl nitrite escapes very rapidly from a glass-stoppered bottle.—Drug. Circ. 1917, v. 61, p. 502; J. Am. Pharm. Assoc. 1917, v. 6, p. 465.

Asher, Philip: An explanation of the U. S. P. IX method for the assay of spirit of nitrous ether.—Am. J. Pharm. 1917, v. 89, p. 172.

Hulbert, Roberts: The nitrous ether content of seven samples of spirit of nitrous ether examined varied from 0.03 per cent to 3.3 per cent. The U. S. P. requires 3.5 per cent to 4.5 per cent.—Bull. North Dakota Exper. Sta. F. Dept. 1917, v. 4, p. 346.

Kebler, L. F., and others: Of 79 samples of spirit of nitrous ether examined, 45, or 57 per cent, failed to come within 20 per cent of the standard; 51, or 64.5 per cent, deviated from the standard in excess of 25 per cent.—J. Am. Pharm. Assoc. 1917, v. 6, p. 685.

Table showing some of the analytical results reported for spirit of nitrous ether.

Reporter.	Number of samples.		References.
	Examined.	Rejected.	
Bachman, G.....	36	33	Proc. Minnesota Pharm. Assoc. 1917, p. 186.
Casey, F. W.....	33	24	Bull. Michigan D. & F. Dept. 1917, No. 256–257, p. 16; No. 258–259, p. 18; No. 260–261, p. 33; No. 262–263, p. 13.
Eskew, Harry L....	14	13	Rep. Tennessee F. & D. Dept. 1917, p. 15.
Frary, Guy G.....	7	4	Rep. South Dakota F. & D. Com. 1917, p. 99.
Lea, E. J.....	2	2	Rep. California Bd. Health, 1917, p. 162.
Sayre et al.....	8	4	Rep. Kansas Bd. Health, 1916, v. 12, p. 428; 1917, v. 13, p. 168.
Todd, A. R.....	9	7	Bull. Michigan D. & F. Dept. 1917, No 264–267, p. 24.
Woods, Charles D..	17	15	Rep. Maine Agric. Exper. Sta. 1917, p. 30–31.
Anon.....	33	20	Bull. Vermont Bd. Health, 1917, v. 18, Nos. 1, 2, 3, and 4.

SPIRITUS AMMONIÆ AROMATICUS.

Dohme, A. R. L.: The committee on standards and deterioration of the American Drug Manufacturers' Association finds it desirable to have an assay process for aromatic spirit of ammonia. The rate

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of deterioration of aromatic spirit of ammonia should also be determined.—Proc. Am. Drug Mfg. Assoc. 1917, p. 184.

Roller, Emil: The ammonium salt contained in the aromatic spirit of ammonia is the carbonate, which results from the action of the ammonium hydroxide upon the commercial carbonate (a mixture of the carbonate and bicarbonate).—D.-A. Apoth.-Ztg. 1917, v. 38, p. 30.

Anon.: Data are given showing the specific gravity and alkalinity of 78 samples of aromatic spirits of ammonia, also the alcoholic content.—Bull. North Dakota Exper. Sta. F. Dept. 1917, v. 4, p. 255.

Sayre et al.: The alkalinity of four samples of aromatic spirit of ammonia tested varied from 1.22 to 1.82; the specific gravity, from 0.8903 to 0.8959; the oil content per liter, from 8.08 cubic centimeters to 10.4 cubic centimeters.—Rep. Kansas Bd. Health, 1916, v. 12, p. 429.

Kebler, L. F., and others: Of 52 samples of aromatic spirit of ammonia examined, 18, or 35 per cent, came within a 10 per cent variation of the U. S. P. standard in ammonia content; 21, or 40 per cent, came within 15 per cent; and 28, or 54 per cent, came within a variation of 20 per cent. The minimum carbonate content varied even more.—J. Am. Pharm. Assoc. 1917, v. 6, p. 615–617.

Casey, F. W.: One sample of aromatic spirit of ammonia examined was rejected for being below standard.—Bull. Michigan D. & F., Dept. 1917, Nó. 260–261, p. 33.

SPIRITUS AMYGDALÆ AMARÆ.

Hortvet, Julius: Of six samples of almond extract examined, three were rejected because they did not meet the U. S. P. requirements.—Rep. Minnesota D. & F. Com. 1917, p. 53.

SPIRITUS ANISI.

Paul, A. E.: Referee report on the examination of flavoring extracts. Data showing the volatile oil content of spirit of anise when determined by the brine method are presented.—J. Assoc. Off. Agric. Chem. 1917, v. 2, p. 210.

Anon.: Two lots of spirit of anise examined were 29 and 30 per cent, respectively, below the official standard.—Rep. Massachusetts Bd. Health, through J. Am. Pharm. Assoc. 1917, v. 6, p. 414.

Anon.: Three of eight samples of spirit of anise examined were adulterated or below standard.—Bull. Vermont Bd. Health, 1917, v. 17, No. 4; v. 8, Nos. 1 and 2.

SPIRITUS CAMPHORÆ.

Fuller, H. C.: The assay of spirit of camphor is limited to natural camphor. A perfectly good spirit can be prepared with artificial

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camphor, but the U. S. P. assay would be of no value in determining its strength.—J. Am. Pharm. Assoc. 1917, v. 6, p. 71.

Kollo, Constantin: A description of a procedure for the quantitative determination of camphor in the spirit of camphor. The method consists in the precipitation of the camphor from its solution with lead acetate, solution of the precipitate in a weighed amount of ether, and calculation of the quality of camphor from the increase in weight of the ethereal solution.—Bull. de Chim. Bukarest, 1916, v. 18, p. 44–48, through Chem. Abstr. 1917, v. 11, p. 1516-1517.

Krauss, Ludwig: The results obtained in the examination of a large number of samples of spirit of camphor obtained from druggists are presented in tabulated form. Attention is directed to a difference in behavior of the natural and synthetic camphor toward Huebl's solution.—Südd. Apoth.-Ztg. 1916, v. 56, p. 248-249, through Chem. Abstr. 1917, v. 11, p. 864.

Kebler, L. F., and others: Of 44 samples of spirit of camphor examined, 19, or 43 per cent, came within a 10 per cent variation from the official standard; 23, or 52 per cent, came within a 15 per cent variation; 27, or 61 per cent, came within a 20 per cent variation.—J. Am. Pharm. Assoc. 1917, v. 6, p. 684-685.

Congdon, Leon A.: Of 517 samples of spirit of camphor examined between 1905 and 1917, 179 were legal, 224 were below standard, and 114 were above standard. On a percentage basis this means 34.62 per cent were legal, 43.33 per cent were below standard, and 22.05 per cent were above standard.—Proc. Kansas Pharm. Assoc. 1917, p. 86.

Table showing some of the analytical results reported for spirit of camphor.

Reporters.	Number of samples.		References
	Examined.	Rejected.	
Barnard, H. E.	18	1	Bull. Indiana Bd. Health, 1917, v. 20, p. 135
Casey, F. W.	15	9	Bull. Michigan D. & F. Dept. 1917, No. 256–257, p. 16; No. 258–259, p. 18; No. 260–261, p. 33; No. 262–263, p. 13.
Frary, Guy G.	16	6	Rep. South Dakota F. & D. Com. 1917, p. 101.
Sayre, et al.	13	3	Rep. Kansas Bd. Health, 1916, v. 12, p. 428; v. 13, p. 168 and 262.
Tice, William G.	18	2	Rep. New Jersey Dept. Health, 1917, p. 62.
Todd, A. R.	12	7	Bull. Michigan D. & F. Dept. 1917, No. 264–267, p. 24.
Woods, Charles D.	82	7	Rep. Maine Agric. Exper. Sta. 1917, p. 33–36.
Anon.	6	1	Bull. Vermont Bd. Health 1917, v. 18, No. 1.

SPIRITUS GAULTHERIÆ.

Paul, A. E.: Referee report on the examination of flavoring extracts. Data obtained with the saponification method for wintergreen extract are presented.—J. Assoc. Off. Agric. Chem. 1917, v. 2, p. 209.

SPIRITUS GLYCERYLIS NITRATIS.

Fuller, H. C.: The U. S. P. assay of spirit of nitroglycerin is open to criticism. The conclusions from the results obtained depend largely upon the personal equation of the analyst, and if the com-

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mercial alcohol used in the preparation of the material contains inert soluble substances in excess of that prescribed by the U. S. P. for pure alcohol, the results will be erroneous.—J. Am. Pharm. Assoc. 1917, v. 6, p. 71.

SPIRITUS LIMONIS, N. F.

Hortvet, Julius: Of 50 samples of lemon extract examined, 17 were rejected for not being up to standard.—Rep. Minnesota D. & F. Com. 1917, p. 53.

SPIRITUS MENTHÆ PIPERITÆ.

Beringer, George M.: The formula for the preparation of the mint spirits has been improved in that more uniformly green colored preparations are obtained through previous washing of the mint leaves with water.—Am. J. Pharm. 1917, v. 89, p. 352.

Paul, A. E.: Referee report on the examination of flavoring extracts. Data obtained in the determination of the volatile oil in spirit of peppermint by the carbon disulphide method are presented.—J. Assoc. Off. Agric. Chem. 1917, v. 2, p. 211.

Congdon, Leon A.: Of 241 samples of essence of peppermint examined between 1905 and 1917, 56 were legal, 169 were below standard, and 16 were above standard. This means that 23.24 per cent were legal, 70.12 per cent were below standard, and 6.64 per cent were above standard.—Proc. Kansas Pharm. Assoc. 1917, p. 87.

Table showing some of the analytical results reported for spirit of peppermint.

Reporters.	Number of samples—		References.
	Examined.	Rejected.	
Casey, F. W.....	3	2	Bull. Michigan D. & F. Dept. 1917, No. 256-257, p. 16; No. 258-259, p. 18.
Frary, Guy G.....	17	2	Rep. South Dakota F. & D. Com. 1917, p. 102.
Hortvet, Julius.....	43	17	Rep. Minnesota D. & F. Com. 1917, p. 53.
Sayre et al.....	9	8	Rep. Kansas Bd. Health, 1916, v. 12, p. 429; 1917, v. 13, p. 171.
Todd, A. R.....	5	1	Bull. Michigan D. & F. Dept. 1917, No. 264-267, p. 24.
Woods, Charles D...	10	5	Rep. Maine Agric. Exper. Sta. 1917, p. 31.
Anon.....	12	4	Bull. Vermont Bd. Health, 1917, v. 18, Nos. 1, 2, & 3.

SPIRITUS MYRCIÆ COMPOSITUS, N. F.

Tice, William G.: Of 108 samples of compound spirit of myrciæ examined, 30 were below standard.—Rep. New Jersey Dept. Health, 1917, p. 62.

STRAMONIUM.

Alsberg, C. L.: An examination of imported samples of stramonium leaves has disclosed that *Xanthium strumarium* L. has been substituted in some instances for the official drug.—S. R. A.-Chem. 1917, No. 20, p. 59.

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Dohme, A. R. L.: On the Pacific coast, *Datura Meteloides* D. C. is being gathered in large quantities and offered as stramonium. It can be readily detected by its soft and short but white pubescence.—Proc. N. W. D. A. 1917, p. 512.

Brinton, Clement S.: In a report on the determination of ash, the ash content of stramonium is given as 18.24 per cent.—J. Assoc. Off. Agric. Chem. 1917, v. 2, p. 207.

Anon.: Of six samples of stramonium leaves assayed, the alkaloidal content of four was above standard and two below.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 92.

Dohme, A. R. L.: Four lots of stramonium examined assayed 0.33 per cent, 0.47 per cent, 0.32 per cent, and 0.40 per cent of alkaloids, respectively.—Proc. N. W. D. A. 1917, p. 511.

Scoville, W. L.: The alkaloidal content of five lots of stramonium leaves examined ranged between 0.27 and 0.57 per cent.—J. Am. Pharm. Assoc. 1917, v. 6, p. 414.

Anon.: Notice of judgment No. 4827 relates to the adulteration of stramonium.—S. R. A.-Chem. 1917, p. 292.

STROPHANTHINUM.

Holste, Arnold: Solutions of g-strophanthin retain their activity unchanged for years, while solutions of k-strophanthin become worthless within a year.—Ztschr. exper. Path. u. Therap. 1917, v. 19, p. 153–161.

STROPHANTHUS.

Rowe, L. W.: A study of the influence of the method of administration upon the degree of toxicity of strophanthus preparations. The subcutaneous and intravenous toxicities of four strophanthus preparations examined were found to be from 45 to 100 times as great as their oral toxicities.—Therap. Gaz. 1917, v. 41, p. 536–540.

Cornwall, Edward E.: An article calling attention to some practical points in the use of strophanthus.—Med. Rec. 1917, v. 92, p. 451–453.

van Leeuwen, W. Storm: Researches on the physiological evaluation of digitalis and strophanthus preparations.—Pharm. Weekbl. 1917, v. 54, p. 391–412.

STRYCHNINA.

Hankin, E. H.: Reactions of strychnine and brucine with Fehling's solution are described.—India J. Med. Res. 1916, v. 4, p. 237–245.

Filippi, E.: Observations on the influence of quinine on the chemical and physiological reactions of strychnine. A chemical test for distinguishing between quinine and strychnine is described.—Schweiz. Apoth.-Ztg. 1917, v. 55, p. 329.

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Ray, Prafulla C.: Descriptions of compounds of strychnine and brucine with mercuric nitrite.—J. Chem. Soc. 1917, v. 111, p. 507–510.

Cutler, Elliott C., and Alton, Benjamin H.: A study of the control of strychnine convulsions by intraspinal injections of magnesium sulphate.—J. Exper. M. 1917, v. 25, p. 83–92.

Hatcher, Robert A., and Eggleston, Cary: Researches to determine the fate of strychnine in the body.—J. Pharmacol. & Exper. Therap. 1917, v. 10, p. 281–319.

Kleiner, I. S., and Meltzer, S. J.: A report on the reduction of the toxicity of strychnine by the administration of large quantities of indifferent fluids.—J. Pharmacol. 1916, v. 9, p. 359.

Shelton, H. P.: A note on the value of apomorphine as an antidote for strychnine poisoning.—Therap. Gaz. 1917, v. 41, p. 456.

STYRAX.

Dohme, A. R. L.: Some of the samples of storax examined were apparently a mixture of balsam Tolu with pine tar. Several samples were adulterated with pine tar.—Proc. N. W. D. A. 1917, p. 521.

Jordan, Stroud: A comparison of the physical and chemical properties of American and oriental storax. The analytical data are presented in the form of a table.—Am. J. Pharm. 1917, v. 89, p. 581–584; J. Ind. & Eng. Chem. 1917, v. 9, p. 770–771.

Henze, M.: A chemical investigation of styrax, with special reference to the identification of abietic and pimaric acids.—Ber. deutsch. chem. Gesellsch. 1916, v. 49, p. 1622, through Zentralb. Biochem. u. Biophys. 1917, v. 19, p. 54.

Holmes, E. M.: Notes on storax and other sources of cinnamic acid.—Perf. & Ess. Oil Rec. 1917, v. 8, p. 70–71.

SUCCUS CITRI, N. F.

Farwell, Oliver Atkins: The words "Linné" and "variety," or "var.," should be inserted between "Medica" and "acida." Bonavia named and described a variety, not a subspecies.—Drug. Circ. 917, v. 61, p. 231.

SULPHONMETHANUM.

Sanchez, Juan A.: Several tests for the identification of sulphonal, trional, and tetronal are described.—Rev. farm. 1917, v. 60, p. 699.

SULPHUR SUBLIMATUM.

Guareschi, I.: A note on the origin of the word "sulphur."—Atti accad. sci. Torino, 1917, v. 52, p. 319–328.

Moles, E.: A discussion of the new values for the atomic weights of sulphur and carbon as given in the international table for 1916.—J. chim. phys. 1917, v. 15, p. 51–59.

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Scidmore, George H.: Approximately 95,000 tons of sulphur were produced in Japan during 1916. About 75,000 tons were exported, of which about one-half went to the United States.—Com. Rep. 1917, No. 49, p. 788.

Neumann, Bernhard: From an investigation of a sample of black sulphur from Mexico the author concludes that the black sulphur described by Magnus and Knapp is not a special modification of sulphur, but ordinary yellow sulphur which has been colored black by small quantities of carbon or metallic sulphides.—Ztschr. angew. Chem. 1917, v. 30, part 1, p. 165–168, through J. Chem. Soc. Lond. 1917, v. 112, part. 2, p. 464.

Fonzes-Diacon: A discussion of the adulteration of sublimed sulphur. Data are given showing the proportion of sublimed and precipitated sulphur insoluble in carbon disulphide.—Ann. falsif. 1916, v. 9, p. 333–339.

Vinassa, G.: An investigation of the influence of natural and accidental impurities in sulphur on the determination of fineness by means of the Chancel tube.—Staz. sper. agric. ital. 1916, v. 49, p. 388–393, through Chem. Abstr. 1917, v. 11, p. 1805.

Guitteau, L.: An investigation of the action of sulphur on barium hydroxide in the presence of water. BaS_6 exists in solution, but decomposes, yielding BaS_4 on evaporation.—Compt. rend. Acad. sc. 1916, v. 163, p. 390–391.

Emich, F.: To detect sulphur, heat a small quantity of the material to be examined in a capillary tube with nitric acid and observe the formation of $BaSO_4$ when a solution of $BaCl_2$ is added.—Ztschr. analyt. Chem. 1917, v. 56, p. 1–13, through J. Chem. Soc. Lond. 1917, v. 112, part 2, p. 218.

Bory and Jacquot: A method is described for preparing a solution of sulphur in sesame oil suitable for injection intravenously.—J. pharm. et. chim. 1917, v. 15, p. 360.

Siegfried, C. F.: A solution of sulphur in carbon disulphide is recommended for use in the treatment of skin diseases where sulphur is indicated.—Proc. Pennsylvania Pharm. Assoc. 1917, v. 40, p. 24.

SUPPOSITORIA.

Roller, Emil: The substitution of a small amount of lanolin for a portion of the cacao butter in the preparation of suppositories is desirable during the cold seasons of the year.—D.-A. Apoth.-Ztg. 1917, v. 38, p. 30.

Anon.: Notes on the preparation of suppositories of glycerin.—N. A. R. D. J. 1917, v. 25, p. 15.

SUPRARENALUM SICCUM.

Snyder, J. P.: The blood-pressure method for the physiological assay of the suprarenal gland is very satisfactory. The method of

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using both femoral veins instead of one does not yield as close checks as when the injection is made into the saphenous vein.—Proc. New York Pharm. Assoc. 1917, p. 228.

White, J. Stanley: A brief discussion of the physiological and chemical methods for the evaluation of the activity of adrenalin solution.—Pharm. J. 1917, v. 98, p. 159–160.

van Leeuwen, W. Storm: Data obtained in the physiological evaluation of adrenalin, nicotine, and lobeline by the blood-pressure method are presented.—Pharm. Weekbl. 1917, v. 54, p. 1329–1334.

Pittenger, Paul S.: Comments on the method of measuring and administering the doses in the biological assay of the suprarenal gland.—J. Am. Pharm. Assoc. 1917, v. 6, p. 870–871.

Hamilton, Herbert C.: The U. S. P. test for suprarenal gland is criticized because of the following features: (1) The complications introduced in the test. (2) The inaccurate manner of measuring the test dose. (3) The incomplete administration of the test dose. (4) The method of making a check assay.—Am. J. Pharm. 1917, v. 89, p. 61–71.

Ogata, Tomosaburo, and Ogata, Akira: An article dealing with Henle's reaction of the cromaffin cells in the adrenales, and the microscopic test for adrenaline.—J. Exper. Med. 1917, v. 25, p. 807–817.

Johannessohn, Fritz: Results obtained with the colorimetric method of Fränkel, Allers, and Bayer in the estimation of adrenalin in commercial preparations, are given.—Biochem. Ztschr. 1916, v. 76, p. 377–391, through J. Chem. Soc. Lond. 1917, v. 112, part 2, p. 55.

Grasset, Raymond: A report of a case of adrenalin poisoning due to the ingestion of two successive doses of 15 and 20 grams of 1 in 1000 adrenalin solution. An abstract.—Presse Medicale, 1917, v. 25, p. 470.

Githins, Thomas S.: A comparative study of certain actions of adrenalin in the cat and the rabbit.—J. Exper. M. 1917, v. 25, p. 323–332.

Meltzer, S. J.: The intraspinal injection of adrenalin is recommended in the treatment of infantile paralysis. The dose recommended is 0.5 cubic centimeter of the solution, to be repeated every 4 to 6 hours.—Year-Book of Pharmacy, 1917, p. 176.

Ercolani, P.: A discussion of suprarenal treatment in nephritis.—Gazzetta degli Ospedali e delle Cliniche, Milan, 1917, v. 38, p. 353, through J. Am. M. Assoc. 1917, v. 68, p. 1670.

Harris, I.: A note on the use of adrenalin in the treatment of nephritis. From 5 to 10 minims of the 1:1000 solution were given by mouth from once to four times daily.—Year-Book of Pharmacy, 1917, p. 176.

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Milan, G.: Observations on the use of adrenalin in the treatment of iodism.—Year-Book of Pharmacy, 1917, p. 176, from Paris méd. 1917, v. 7, p. 374.

SYRUPI.

Cook, E. F.: A discussion of the syrups and elixirs of the U. S. P., IX, and the N. F., IV.—Midl. Drug. 1917, v. 51, p. 88–91.

Hommell, P. E.: Syrup of garlic, syrup of althea, syrup of asarum, syrup of ferrous chloride, syrup of krameria, syrup of poppy, and syrup of sanguinaria should be dismissed from the N. F. without further comment.—Proc. New Jersey Pharm. Assoc. 1917, p. 79.

Helch, Hans: Equivalents of saccharine solutions and sugar syrups of equal sweetening power are given.—Schweiz. Apoth.-Ztg. 1917, v. 55, p. 239.

Repetto, Ernesto: Descriptions of methods for the detection and estimation of saccharin in syrups and other pharmaceutical preparations.—Rev. Farm. 1917, v. 60, p. 407–419.

Jalowetz, E.: Notes on the preparation of an albumin containing syrup by the action of yeast on solutions of sucrose.—Chem. Ztg. 1916, v. 40, p. 893–894.

Konantz, W. A.: A discussion of a proposed formula for the preparation of a compound syrup of pepsin intended to pass the criticisms made on the pepsin preparations of the N. F.—J. Am. Pharm. Assoc. 1917, v. 6, p. 243–253.

Hommell, P. E.: A standard aromatic syrup of chocolate should be introduced into the N. F. Such a syrup is an ideal agent to cover the bitter taste of the alkaloids of cinchona bark and is useful to conceal the acrid and nauseous taste of other substances.—Proc. New Jersey Pharm. Assoc. 1917, p. 80

SYRUPUS.

Roller, Emil: Syrup made by the cold process is superior to that made by the hot process. The latter becomes sour and cloudy much sooner than the former.—D.-A. Apoth.-Ztg. 1917, v. 38, p. 30–31.

Mayer: The presence of invert sugar in simple syrup does not always indicate adulteration. Data are given showing that the cane sugar in syrup is inverted on standing.—Répert. Pharm., through Giorn. farm. chim., 1917, v. 66, p. 286.

SYRUPUS ACIDI HYDRIODICI.

Beringer, George M.: The acid content of syrup of hydriodic acid has been slightly increased in order that the official syrup will not be below the strength claimed for some of the proprietary syrups.—Am. J. Pharm. 1917, v. 89, p. 352.

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SYRUPUS AURANTII.

Cook, E. Fullerton: In the formula for the preparation of syrup of orange, the magnesium carbonate has been replaced by purified talc, since the alkaline carbonate was found to injure the delicacy of the orange flavor.—J. Am. Pharm. Assoc. 1917, v. 6, p. 76.

Lascoff, J. Leon: The substitution of purified talc for magnesium carbonate in the preparation of the syrup of orange is not satisfactory, as the time consumed in filtration is lengthened and the finished product is not as clear as when magnesium carbonate is used.—Am. Druggist 1917, v. 65, No. 5, p. 25.

Hommell, P. E.: The oil of orange should replace the tincture of sweet orange peel in the syrup of orange. The peel contains gummy and other matters which are prone to decomposition. Glycerin should be added and the syrup made denser.—Proc. New Jersey Pharm. Assoc. 1917, p. 79.

SYRUPUS BROMIDORUM, N. F.

Hommell, P. E.: Fear is expressed that the syrup of bromides will not become very popular as a sedative and antispasmodic, as it contains too much flavor, and the sugar present is likely to upset sensitive stomachs.—Proc. New Jersey Pharm. Assoc. 1917, p. 79.

SYRUPUS CALCII LACTOPHOSPHATIS.

Beringer, George M.: The addition of 50 mils of glycerin to the liter in the preparation of the syrup of calcium lactophosphate, as directed in the U. S. P., IX, adds materially to the stability of the syrup.—Am. J. Pharm. 1917, v. 89, p. 353.

SYRUPUS CIMICIFUGÆ COMPOSITUS, N. F.

Anon.: Comments on the N. F. directions for the preparation of the compound syrup of cimicifuga.—N. A. R. D. J. 1917, v. 23, p. 764.

SYRUPUS CODEINÆ, N. F.

Hommell, P. E.: The syrup of codeine requires some glycerin to preserve it, as it has been found not to keep well. Otherwise it is a desirable preparation as a sedative and anodyne.—Proc. New Jersey Pharm. Assoc. 1917, p. 79.

SYRUPUS ERIODICTYI AROMATICUS, N. F.

Hommell, P. E.: The aromatic syrup of yerba santa is a most efficient disguiser of bitter drugs and a valuable associate for expectorant mixtures. It is suggested that the quantity of sugar in the formula be lessened, and that glycerin be substituted on account of its greater solvent and preservative action.—Proc. New Jersey Pharm. Assoc. 1917, p. 79.

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SYRUPUS FERRI ET MANGANI IODIDI, N. F.

Hommell, P. E.: The syrup of iron and manganese iodide is one of the best tonics and alteratives in fluid form. The formula can not be improved, and from a therapeutic standpoint it will replace all the trade-marked ferruginous tonics ever offered to the profession and public.—Proc. New Jersey Pharm. Assoc. 1917, p. 79.

SYRUPUS FERRI IODIDI.

Anon.: Comments on the U. S. P. method for the preparation and preservation of syrup of ferrous iodide.—N. A. R. D. J. 1917, v. 24, p. 199.

Utech, P. Henry: If a small piece of metallic iron be placed in the finished syrup of ferrous iodide, exposure to light will not impair its quality, nor will it be necessary to keep the product stored in amber-colored bottles.—Drug. Circ. 1917, v. 61, p. 397.

Hulbert, Roberts: A sample of syrup of iodide of iron examined contained nearly twice the amount of ferric iodide required by the U. S. P.—Bull. North Dakota Exper. Sta. F. Dept. 1917, v. 4, p. 345.

SYRUPUS FICORUM COMPOSITUS, N. F.

Anon.: Notes on the preparation of the compound syrup of figs.—N. A. R. D. J. 1917, v. 25, p. 455–456.

SYRUPUS GLYCYRRHIZÆ, N. F.

Hommell, P. E.: The syrup of licorice is a nonalcoholic preparation, which will answer every call as a vehicle for acrid and nauseous drugs. It is also of value to conjoin with expectorant and laxative mixtures.—Proc. New Jersey Pharm. Assoc. 1917, p. 79.

SYRUPUS HYPOPHOSPHITUM, N. F.

Cook, E. Fullerton: The syrup of hypophosphites may be made advantageously by mixing the hypophosphites with the sugar and percolating this mixture with the glycerin and water menstruum. A clear filtered syrup is thus produced with little trouble or danger of contamination from dust and other foreign substances.—J. Am. Pharm. Assoc. 1917, v. 6, p. 76.

Beringer, George M.: The addition of 50 mils of glycerin to the liter in the preparation of the syrup of hypophosphites, as directed in the U. S. P., IX, adds materially to the stability of the syrup.—Am. J. Pharm. 1917, v. 89, p. 353.

Anon.: A note warns against the heating of syrup of hypophosphites, since the hypophosphite salts are decomposed by heating even at the boiling temperature.—Pharm. Ztg. 1917, p. 524, through Schweiz. Apoth.-Ztg. 1917, v. 55, p. 682.

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SYRUPUS HYPOPHOSPHITUM COMPOSITUS, N. F.

Anon.: There is an error in the N. F. formula for compound syrup of hypophosphites in that an excessive amount of water is directed to be used. The quantity specified should be changed from 450 milliliters to 400 milliliters.—Drug. Circ. 1917, v. 61, p. 247.

Anon.: Notes on the preparation of the compound syrup of hypophosphites.—N. A. R. D. J. 1917, v. 25, p. 455.

SYRUPUS IODOTANNICUS, N. F.

Manseau: A formula for the preparation of a stock mixture intended to be used in making syrup of iodotannin is given.—Répert. pharm. 1917, v. 28, p. 260-261.

SYRUPUS IPECACUANHÆ.

Cook, E. Fullerton: The syrup of ipecac now contains about 1 per cent of acetic acid in addition to the hydrochloric acid contained in the fluid extract, due apparently to a lack of harmony in the work of the subcommittees.—J. Am. Pharm. Assoc. 1917, v. 6, p. 76.

Rippetoe, J. R.: Hydrochloric acid is used in the preparation of the fluid extract of ipecac, while acetic acid is used in preparing the syrup from the fluid extract. If the additional acid is necessary, the kind used should be the same in both cases.—Drug. Circ. 1917, v. 61, p. 502; J. Am. Pharm. Assoc. 1917, v. 6, p. 464.

SYRUPUS IPECACUANHÆ ET OPII, N. F.

Hommell, P. E.: The syrup of ipecac and opium is of value in many inflammatory conditions of the bronchial-pulmonary system, especially so when combined with the ammonium salts, terpin hydrate. etc.—Proc. New Jersey Pharm. Assoc. 1917, p. 79.

SYRUPUS MANNÆ, N. F.

Hommell, P. E.: The laxative properties of the syrup of manna could be increased by the addition of senna. It would then prove a dependable cholagogue favoring the secretion and excretion of bile, thus preventing liver congestion and torpidity.—Proc. New Jersey Pharm. Assoc. 1917, p. 79.

SYRUPUS MORPHINÆ ET ACACIÆ, N. F.

Hommell, P. E.: Syrup of morphine and acacia should be eliminated from the N. F. It is claimed to be a pectoral syrup. It is, however, simply an anodyne demulcent and has nothing of an expectorant character about it.—Proc. New Jersey Pharm. Assoc. 1917, p. 79.

SYRUPUS PAPAVERIS, N. F.

Hommell, P. E.: Owing to the variable proportion of opium in poppy capsules, the syrup of poppy is uncertain in its effects, and is capable of doing serious injury to young children. If a narcotic of

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weak character is required it would certainly be better for the physician to add a definite proportion of opium to a suitable vehicle.—Proc. New Jersey Pharm. Assoc. 1917, p. 79.

SYRUPUS PINI STROBI COMPOSITUS, N. F.

Anon.: Comments on the formula for the preparation of compound syrup of white pine.—N. A. R. D. J. 1917, v. 23, p. 593.

SYRUPUS PRUNI VIRGINIANÆ.

Beringer, George M.: The addition of glycerin to the first portion of the menstruum instead of to the percolate in the preparation of the syrup of wild cherry is thought to be a questionable procedure. The syrup obtained by this method may be deeper in color and richer in tannin, but it is doubtful whether the hydrocyanic acid content is as great as when the syrup is prepared by the U. S. P., VIII, method.—Am. J. Pharm. 1917, v. 89, p. 353.

Cook, E. Fullerton: The U. S. P., VIII, formula for the preparation of syrup of wild cherry was criticized because it did not yield a syrup of sufficiently high color. The syrup made by the U. S. P., IX, process corrects this deficiency, but contains tannin and does not possess so pleasant a flavor.—J. Am. Pharm. Assoc. 1917, v. 6, p. 76.

Utech, P. Henry: The characteristic flavor of the syrup of wild cherry is entirely dissipated in a few months if the syrup be left exposed to the light.—Drug. circ. 1917, v. 61, p. 397.

SYRUPUS QUINIDINÆ, N. F.

Hommell, P. E.: Where a bitterless febrifuge is desired there is no better remedy than syrup of quinidine. It is palatable and curative. The addition of 5 per cent of glycerin to the mixture is suggested.—Proc. New Jersey Pharm. Assoc. 1917, p. 79.

SYRUPUS SENNÆ COMPOSITUS, N. F.

Hommell, P. E.: The syrup of senna compound is a most satisfactory formula to replace nostrums—a most agreeable laxative and cathartic to take. The doctors should take notice of this galenical, as it will please the most fastidious.—Proc. New Jersey Pharm. Assoc. 1917, p. 79.

SYRUPUS STILLINGIÆ COMPOSITUS, N. F.

Hommell, P. E.: The compound syrup of stillingia is far superior to the syrup of sarsaparilla compound as a dependable alterative and tonic, and, when properly conjoined with the iodides and mercurials, no prescriber will be disappointed.—Proc. New Jersey Pharm. Assoc. 1917, p. 79.

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TALCUM PURIFICATUM.

Anon.: A short note on the location of the talc deposits of Brazil.—Am. Perf. 1917, v. 11, p. 337.

Anon.: The following test for talcum is recommended for the Swedish pharmacopœia: When 5 grams of talcum are boiled with 25 cubic centimeters of N/1 hydrochloric acid, not less than 22 cubic centimeters of N/1 caustic potash solution should be required to neutralize the excess of acid.—Apoth. Ztg. 1917, p. 108 through Pharm. Weekbl. 1917, v. 54, p. 1172.

TARAXACUM.

Farwell, Oliver Atkins: The proper designation under taraxacum is *Taraxacum Taraxacum* (Linné.) Karsten.—Drug. Circ. 1917, v. 61, p. 175.

Alsberg, C. L.: Samples of a recent importation of dandelion root contained about 40 per cent of roots which were badly discolored on the interior and did not show a porous, pale yellow wood, as required by the U. S. P., IX.—S. R. A.-Chem. 1917, No. 20, p. 58.

TEREBINTHINÆ, N. F.

Schorger, A. W., and Pettigrew, R. L.: A report on the increased yield of turpentine and rosin from double chipping.—Bull. U. S. Dept. Agric. Forest Products Lab. 1917, No. 567, p. 1–9.

Ostlund, J.: A report of experiments to determine the composition and properties of the oleoresin obtained from *Pinus Jeffreyi.*—J. Am. Pharm. Assoc. 1917, v. 6, p. 137.

Anon.: Extract from the report of the Comité d'Action of the Eighteenth district on the methods of adulteration of turpentine and legal means of controlling it.—Ann. falsif. 1913, v. 10, p.33–47.

TEREBINTHINA LARICIS, N. F.

Farwell, Oliver Atkins: The proper designation of the species of larch producing Venice turpentine is *Larix Larix* (Linné) Karsten.—Drug. Circ. 1917, v. 61, p. 231.

Anon.: The genuineness of Venice turpentine may be tested as follows: Dissolve 5 gms. of the sample in 20 cubic centimeters of 95 per cent alcohol; add a few drops of phenolphthalein and sufficient of a 10 per cent solution of potassium hydroxide to render it alkaline. With genuine Venice turpentine a clear solution is obtained, while the spurious yields a turbid solution, from which, on standing, drops of oily resin separate.—Pharm. J. 1917, v. 98, p. 506.

TERRA SILICEA PURIFICATA.

Anon.: Kieselguhr is a much more efficient filtering medium than talc or calcium phosphate.—Meyer Bros. Drug. 1917, v. 38, p. 181.

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THYMOL.

Anon.: The leaves of *Ocimum viride* are stated to be a possible new source of thymol. Leaves from the four-months-old plant yielded 0.5 per cent of oil, the oil containing 62 per cent of thymol.—Bull. Imp. Inst. 1917, v. 15, p. 322–325.

Marquina, M.: Data relative to the solubility of thymol in mixtures of water and glycerol are given. At 25° C., 100 parts of water dissolved 0.0952 part of thymol and 100 parts of glycerin dissolved 1.71 parts.—J. Chem. Soc. Lond. 1917, v. 112, part 1, p. 689 from Anal. fis. quim. 1917, v. 15, p. 262–271.

Elion, H.: The author claims that he had previously published the bromine method for the determination of thymol, salicylates, and similar compounds described by Seidell. His publication appears in Rec. trav. chim. 1888, v. 7, p. 211.—J. Am. Chem. Soc. 1917, v. 39, p. 1513.

Reid, E. Emmet: The detection of thymol by means of α-bromo-p-nitrotoluene is decribed.—J. Am. Chem. Soc. 1917, v. 39, p. 304–309.

Formánek, J., and Knop, J.: In a review of the spectroscopic identification of phenols the identification of thymol by means of the spectrum of its phthalein condensation product is discussed.—Ztschr. analyt. Chem. 1917, v. 56, p. 273–298, through J. Soc. Chem. Ind. 1917, v. 36, p. 922.

Astruc and Cambe: Notes on the incompatibility of thymol with quinine hydrochloride and santonine. Thymol forms a pasty mass with the first and a fluid with the latter.—J. pharm. et chim. 1917, v. 15, p. 383.

Washburn, B. E.: A report on the effectiveness of thymol in the treatment of hookworm.—J. Am. M. Assoc. 1917, v. 68, p. 1162–1163.

THYMOLIS IODIDUM.

Asher, Philip: An explanation of the chemistry of the U. S. P., IX, method for the assay of thymol iodide.—Am. J. Pharm. 1917, v. 89, p. 168.

THYMUS, N. F.

Dohme, A. R. L.: Two samples of thyme examined consisted of creton ditanny (organum dittany).—Proc. N. W. D. A. 1917, p. 520.

THYROIDEUM SICCUM.

Kendall, E. C.: A report of researches dealing with the active constituent of the thyroid gland, its isolation, chemical properties, and physiologic action.—Endocrinology, 1917, v. 1, p. 153–169, through Physiol. Abstr. 1917, v. 2, p. 350.

Pellegrini, Rinaldo: Thyroid studies. I. Relations between the histological structure of the thyroid gland and its iodine content.—

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Arch. sci. med. 1916, v. 40, p. 92–123, through Chem. Abstr. 1917, v. 11, p. 475.

van Os, D.: Notes on the determination of iodine in thyroid glands and in mineral waters.—Pharm. Weekbl. 1917, v. 54, p. 350–353.

Rogoff, J. M.: A physiological method for the standardization of thyroid preparations makes use of the specific effect of thyroid feeding on tadpoles.—J. Pharmacol. 1917, v. 10, p. 109–208.

Rogoff, J. M., and Marine, David: An account of attempts to produce a substance with thyroid-like activity by the artificial iodization of proteins.—J. Pharmacol. & Exper. Therap. 1917, v. 10, p. 321–325.

Carver, A. E.: Comments on dosage in the therapeutic administration of thyroid gland substance.—Brit. M. J. 1917, v. 2, p. 515.

Basinger, H. R.: An investigation of the alleged detoxicating power of the thyroid gland with respect to bacterial toxins. The positive results reported by Renedi were not confirmed.—J. Infect. Dis. 1917, v. 20, p. 131–139.

Kuriyama, Shigenobu: A study of the influence of thyroid feeding upon carbohydrate metabolism.—Am. J. Physiol. 1917, v. 42, p. 481–496.

TINCTURÆ.

Congdon, Leon A.: Among the tictures found to be deteriorated in drug stores of Kansas were the following: Tincture of digitalis, gelsemium, and gentian compound.—Proc. Kansas Pharm. Assoc. 1917, p. 88.

Hommell, P. E.: It is suggested that the N. F. should contain a 10 per cent tincture of sage, as it is oftentimes called for to combine with resorcin, glycerin, and bay rum for scalp treatment.—Proc. New Jersey Pharm. Assoc. 1917, p. 83.

Hommell, P. E.: The tinctures of asafetida, cardamom, pyrethrum, squill, and stramonium should have been dropped from the U. S. P. or placed in the N. F. to keep steady company with the tincture of nutgall.—Proc. New Jersey Pharm. Assoc. 1917, p. 83.

TINCTURA ACONITI.

Anon.: Forty samples of tincture of aconite assayed 0.013 to 0.051 gm. aconitine to 100 cubic centimeters. Twenty-eight were below the U. S. P. standard of 0.045 gm.—Bull. Connecticut Agric. Exper. Sta., through J. Am. Pharm. Assoc. 1917, v. 6, p. 310.

Anon.: Of 97 samples of tincture of aconite examined, 44 were not within 10 per cent of the official strength.—Bull. North Dakota Agric. Exper. Sta., through J. Am. Pharm. Assoc. 1917, v. 6, p. 310.

Congdon, Leon A.: Of 83 samples of tincture of aconite examined between 1905 and 1917, only 5 were legal and 78 were below the

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standard. The percentages show 6.02 per cent legal and 63.98 per cent illegal.—Proc. Kansas Pharm. Assoc. 1917, p. 87.

Sayre et al.: Two of 12 samples of tincture of aconite assayed contained more than the required amount of ether-soluble alkaloids.—Rep. Kansas Bd. Health, 1917, v. 13, p. 264.

TINCTURA ARNICÆ.

Congdon, Leon A.: Of 20 samples of tincture of arnica examined between 1905 and 1917, 14 were legal and 6 illegal. Percentages show 70 per cent passed and 30 per cent not passed. Proc. Kansas Pharm. Assoc. 1917, p. 87.

Hulbert, Roberts: Two samples of tincture of arnica examined were low in alcohol content.—Bull. North Dakota Exper. Sta. F. Dept. 1917, v. 4, p. 344.

Sayre et al.: One of three samples of tincture of arnica tested was low in alcohol content.—Rep. Kansas Bd. Health,1917, v. 13, p. 262.

TINCTURA BENZOINI.

Casey, F. W.: Of 31 samples of tincture of benzoin examined, 13 were rejected for being below standard.—Bull. Michigan D. & F. Dept. 1917, No. 258–259, p. 18; No. 260–261, p. 33.

TINCTURA CACTI GRANDIFLORI, N. F.

Anon.: Comments relative to the procuring of the cactus for the preparation of the tincture of cactus grandiflorus.—N. A. R. D. J. 1917, v. 24, p. 405–406.

TINCTURA CALUMBÆ.

Casey, F. W.: Of three samples of tincture of calumba examined, one was not of U. S. P. quality.—Bull. Michigan D. & F. Dept. 1917, No. 258–259, p. 18.

TINCTURA CANTHARIDIS.

Scoville, W. L.: A discussion of various menstrua for exhausting cantharides in the preparation of the tincture.—J. Am. Pharm. Assoc. 1917, v. 6, p. 798–800.

TINCTURA CARDAMOMI COMPOSITA.

Casey, F. W.: Of three samples of tincture of cardamom compound examined, one was not of U. S. P. quality.—Bull. Michigan D. & F. Dept. 1917, No. 258–259, p. 18.

TINCTURA CINCHONÆ.

Hebeisen, F.: A method for the assay of tincture of cinchona is described in detail. Tragacanth is used to facilitate filtration of the mixture used for extracting the alkaloids.—Pharm. Weekbl. 1917, v. 54, p. 1175.

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TINCTURA CINCHONÆ COMPOSITA.

Rippetoe, J. R.: The use of red cinchona of high assay diluted to standard in the finished product will produce a preparation of varying strength with reference to the bitter orange peel and serpentaria.—Drug. Circ. 1917, v. 61 p, 502; J. Am. Pharm. Assoc. 1917, v. 6, p. 465.

McElhenie, Thomas D.: The use of 1 per cent hydrochloric acid in the preparation of the compound tincture of cinchona is recommended in order to avoid precipitation of the cinchotannic acid and alkaloids upon standing.—Am. J. Pharm. 1917, v. 89, p. 309–310.

TINCTURA DIGITALIS.

Scoville, Wilbur L.: The tincture of digitalis of the U. S. P., VIII, was pharmaceutically satisfactory but not therapeutically reliable. In order to impart greater stability to the preparation, the alcoholic strength of the menstruum employed was increased.—Am. Druggist 1917, v. 65, No. 1, p. 25.

TINCTURA FERRI CHLORIDI.

Roller, Emil: The tincture of ferric chloride should be classed as a liquor and given the title, "Liquor Ferri Chloridi Alcoholicus."—D.-A. Apoth.-Ztg. 1917, v. 38, p. 31.

Duncan, William: A note on the method for compounding a prescription containing sodium salicylate, sodium bicarbonate, tincture of ferric chloride, and water.—Pharm. J. 1917, v. 98, p. 236.

Table showing some of the analytical results reported for tincture of ferric chloride.

Reporters.	Number of samples—		Reference.
	Examined.	Rejected.	
Eskew, Harry L....	2	1	Rep. Tennessee F. & D. Dept. 1917, p. 15.
Hulbert, Roberts...	96	38	Bull. North Dakota Exper. Sta. F. Dept. 1917, v. 4, p. 341.
Lea, E. J.....	1	1	Rep. California Bd. Health, 1917, p. 162.
Price, J. D.....	33	10	Bull. Georgia Dept. Agric. 1917, v. 4, No. 1, p. 11-12.
Sayre, et al.....	5	1	Rep. Kansas Bd. Health, 1917, v. 13, p. 168
Tice, William G....	51	16	Rep. New Jersey Dept. Health, 1917, p. 62.

TINCTURA GALLÆ, N. F.

Scoville, Wilbur L.: Apparently the subcommittee which recommended the deletion of tincture of nutgall from the U. S. P. judged the various astringent preparations by their palatability and therapeutic usefulness, but found no information concerning their stability. There is reason for believing, however, that tincture of nutgall is the most stable and therefore the most reliable of the astringent preparations.—Am. Druggist, 1917, v. 65, No. 1, p. 25.

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Rusby, H. H.: The ointment of nutgall is official in the U. S. P. and the tincture is official in the N. F. It is not understood why the tincture is not also in the U. S. P.—Proc. Am. Drug Mfg. Assoc. 1917, p. 11; Pract. Drug. 1917, v. 35, No. 3, p. 27.

TINCTURA GAMBIR COMPOSITA.

Anon.: Notes on the preparation of the compound tincture of gambir.—N. A. R. D. J. 1917, v. 24, p. 405.

Congdon, Leon A.: Tincture of catechu gelatinizes on aging if not properly stored.—Proc. Kansas Pharm. Assoc. 1917, p. 88.

TINCTURA GELSEMII.

Casey, F. W.: Of four samples of tincture of gelsemium examined, two were not of U. S. P. quality.—Bull. Michigan D. & F. Dept. 1917, No. 258–259, p. 18.

TINCTURA HYOSCYAMI.

Anon.: Experiments conducted in the H. K. Mulford laboratories to determine the effect of heat upon the results obtained in the alkaloidal assay of hyoscyamus, showed that the assay results are practically not affected by the evaporation of the tincture at the temperature of a water bath.—Drug. Circ. 1917, v. 61, No. 3, p. 25.

TINCTURA IODI.

Roller, Emil: Tincture of iodine should be classed with the liquors and given the title, "Liquor Iodi Alcoholicus."—D.-A. Apoth.-Ztg. 1917, v. 38, p. 31.

Lascoff, J. Leon: The addition of water in the preparation of the tincture of iodine, as directed by the U. S. P., IX, is a great improvement over the method formerly official, as the ingredients are much more easily dissolved.—Am. Druggist, 1917, v. 65, No. 5, p. 26.

Terry, Robert W.: The contraction of the ethyl alcohol volume, and temperature changes which take place in the mixing of the ingredients in the preparation of the tincture of iodine are discussed.—Midl. Drug. 1917, v. 51, p. 419.

Stewart, A. H.: French patent No. 479819 describes the preparation of solid tincture of iodine using soap, 200 grams; alcohol, 400 cubic centimeters; tincture of iodine, 400 cubic centimeters.—Chem. Abstr. 1917, v. 11, p. 868.

Rho, F.: A discussion of substitutes for tincture of iodine which were employed during the war on account of the inconvenience experienced in the use of the tincture.—Schweiz. Apoth.-Ztg. 1916, v. 54, p. 203–205.

Dohme, A. R. L.: The method for the determination of potassium iodide in tincture of iodine is not entirely satisfactory, as the heating

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of the tincture to drive off the iodine usually causes a loss of material. It is much simpler to convert the iodine into halide by hydrosulphite or sulphite, and to titrate the total amount of halide present.—Proc. N. W. D. A. 1917, p. 504.

Congdon, Leon A.: Of 517 samples of tincture of iodine examined between 1905 and 1917, 161 were legal, 234 were below standard, and 122 above the standard or "too strong." On a percentage basis this would mean 31.14 per cent legal, 45.26 per cent below standard, and 23.60 per cent above standard.—Proc. Kansas Pharm. Assoc. 1917, p. 86.

Kebler, L. F., and others: Of the 65 samples of tincture of iodine examined, 38, or 58 per cent, came within a 10 per cent variation from the iodide standard; 48, or 74 per cent, came within a 15 per cent variation. With respect to the iodine content, 18, or 28 per cent, exceeded a 25 per cent limit.—J. Am. Pharm. Assoc. 1917, v. 6, p. 686–687.

Table showing some of the analytical results reported for tincture of iodine.

Reporters.	Number of samples—		References.
	Examined.	Rejected.	
Anon	28	5	Bull. Vermont Bd. Health, 1917, v. 18, Nos. 1, 3 & 4.
Bachman, G	19	6	Proc. Minnesota Pharm. Assoc. 1917, p. 186.
Casey, F. W	55	32	Bull. Michigan D. & F. Dept. 1917, No. 256–257, p. 16; No. 258–259, p. 18; No. 260–261, p. 33; No. 262–263, p. 13.
Eskew, Harry L	55	23	Rep. Tennessee F. & D. Dept. 1917, p. 15.
Frary, Guy G	12	5	Rep. South Dakota F. & D. Com. 1917, p. 101.
Jongeward, Matty	35	17	Bull. North Dakota Exper. Sta. F. Dept. 1917, v. 4, p. 271.
Lea, E. J	34	8	Rep. California Bd. Health, 1917, p. 162.
Pozen, M. A	4	2	Rep. District of Columbia Health Off. 1917, p. 50.
Price, J. D	45	28	Bull. Georgia Dept. Agric. 1917, v. 4, No. 1, p. 13–15.
Sayre et al	8	4	Rep. Kansas Bd. Health, 1917, v. 13, p. 169.
Tice, William G	10	6	Rep. New Jersey Health, 1917, p. 62.
Todd, A. R	24	13	Bull. Michigan D. & F. Dept. 1917, No. 264–267, p. 24.
Woods, Charles D	20	5	Rep. Maine Agric. Exper. Sta. 1917, p. 32.

TINCTURA IODI DECOLORATA, N. F.

Bohrisch, P.: The crystalline precipitate frequently noted in decolorized tincture of iodine probably consists of sodium tetrathionate and free sulphur.—Pharm. Zentralh. 1917, v. 58, p. 611–613.

TINCTURA KINO.

Congdon, Leon A.: Tincture of kino, if not properly stored, gelatinizes on aging.—Proc. Kansas Pharm. Assoc. 1917, p. 88.

Lascoff, J. Leon: The tincture of kino is now a stable preparation owing to the improvement in the U. S. P. method of manufacture.—Am. Druggist, 1917, v. 65, No. 5, p. 26.

TINCTURA LOBELIÆ.

Anon.: A criticism of the U. S. P. method for the preparation of tincture of lobelia states that the drug contains an alkaloid readily

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decomposed on heating, and a pungent volatile oil which is almost entirely dissipated in the process of drying, and that, therefore, the fresh drug must be used in order to obtain a preparation having the full activity of lobelia.—N. A. R. D. J. 1917, v. 25, p. 185–186.

TINCTURA MYRRHÆ.

Casey, F. W.: Of 15 samples of tincture of myrrh examined, 10 did not meet the U. S. P. requirements.—Bull. Michigan D. & F. Dept. 1917, No. 258–259, p. 18; No. 262–263, p. 13.

TINCTURA NUCIS VOMICÆ.

Lascoff, J. Leon: Very few pharmacists will be able to prepare the tincture of nux vomica according to the directions given in the new U. S. P., as an alkaloidal assay is required. The latter, however, is justified, as the tincture has in the past been of unknown strength and of variable activity.—Am. Druggist, 1917, v. 65, No. 5, p. 26.

Sayre et al.: Three samples of tincture of nux vomica assayed were of U. S. P. quality.—Rep. Kansas Bd. Health, 1917, v. 13, p. 263.

Congdon, Leon A.: Of 41 samples of tincture of nux vomica examined between 1905 and 1917, 16 were passed, 21 were below standard, and 4 were above standard, making percentages of 39.02 per cent legal and 63.98 per cent illegal.—Proc. Kansas Pharm. Assoc. 1917, p. 87.

TINCTURA OPII CAMPHORATA.

Kebler, L. F., and others: Of 99 samples of paregoric examined, 72, or 73 per cent, came within a 20 per cent variation from the U. S. P. standard, and 23, or 23 per cent, exceeded a 25 per cent variation.—J. Am. Pharm. Assoc. 1917, v. 6, p. 618–621.

Towns, Charles B.: The drug habit may be established just as easily by taking paregoric daily as by taking morphine straight by the mouth in small quantities; yet, at the present time, druggists have a perfect legal right to sell this preparation without a prescription in any quantity they may see fit.—Pharm. Era, 1917, v. 50, p. 14.

TINCTURA QUASSIÆ.

Casey, F. W.: Three of four samples of tincture of quassia examined were not of U. S. P. quality.—Bull. Michigan D. & F. Dept. 1917, No. 258–259, p. 18; No. 260–261, p. 33.

TINCTURA RHEI.

Congdon, Leon A.: A yellow precipitate forms in tincture of rhubarb on aging. King found this to be chrysophanic acid.—Proc. Kansas Pharm. Assoc. 1917, p. 88.

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TINCTURA STRAMONII.

Fleagle, M. M.: A discussion of the physiological action of the tincture prepared from powdered stramonium seeds.—Hahnemann. Month. 1917, v. 52, p. 106–110.

TINCTURA VANILLÆ, N. F.

Schlotterbeck, J. O.: An account of researches on vanilla extract.—Am. Perf. 1917, v. 11, p. 322–323, 356–357.

Shaffner, Samuel E.: Some reasons why vanilla beans should be chopped instead of ground for the preparation of the tincture of vanilla.—Simmon's Spice Mill, 1917, v. 40, p. 1074–1076.

McGill, A.: Of 125 samples of commercial extract of vanilla examined in Canada, 54 were artificial, 12 were adulterated, and 3 were doubtful.—Bull. Lab. Inl. Rev. Dept. Canada, 1917, No. 369, p. 4; Pract. Drug. 1917, v. 35, No. 12, p. 40.

TINCTURA ZINGIBERIS.

Snyder, J. P.: It is suggested that the following standards replace those now given in the U. S. P. for tincture of ginger: Solids, from 1.25 to 1.75 per cent; alcohol, about 90 per cent. The water-soluble test may be dropped, as the information obtained from the same is of no practical value if the alcohol content is in the neighborhood of 90 per cent.—J. Am. Pharm. Assoc. 1917, v. 6, p. 713–714.

Congdon, Leon A.: Of 99 samples of tincture of ginger examined between 1905 and 1917, 63 were classed as passed, 31 as below standard, and 5 above standard. Percentages show 63.63 per cent passed, 31.31 per cent below standard, and 5.06 per cent above standard.—Proc. Kansas Pharm. Assoc. 1917, p. 87.

Casey, F. W.: Two samples of tincture of ginger examined were not of U. S. P. quality.—Bull. Michigan D. & F. Dept. 1917, No. 260–261, p. 33.

Sayre et al.: Five of eight samples of tincture of ginger tested were low in total solids or alcoholic content.—Rep. Kansas Bd. Health, 1917, v. 13, p. 171.

Todd, A. R.: Of three samples of tincture of ginger examined, two did not meet the U. S. P. requirements.—Bull. Michigan D. & F. Dept. 1917, No. 264–267, p. 24.

TOXITABELLÆ HYDRARGYRI CHLORIDI CORROSIVI.

Levy, L. S.: U. S. patent No. 1,204,794 describes the preparation of mercuric chloride tablets. These tablets contain oleoresin of capsicum and volatile oil of mustard, which prevent their being swallowed by mistake.—Chem. Abstr. 1917, v. 11, p. 185.

Walter: A comparison of the methods of the Ph. Germ. V. and of Sasse for the assay of tablets of mercuric chloride. The method of

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the Ph. Germ. is stated to give low results and to be faulty in other respects.—Pharm. Ztg. 1916, v. 61, p. 298–299, through Chem. Abstr. 1917, v. 11, p. 151.

TRAGACANTHA.

Dohme, A. R. L.: Turkish tragacanth is no longer in the market. Persian gum can be obtained, and, while it does not average as high in quality as the Turkish, very satisfactory grades are obtained in small quantities.—Proc. N. W. D. A. 1917, p. 511.

Hanansek, T. F.: A substitute for tragacanth was found on analysis to consist of a mixture of gypsum and powdered nourtoak root (*Radix carniolæ*).—Arch. Chem. Mikros. 1916, v. 9, p. 69–77, through Chem. Abstr. 1917, v. 11, p. 1330.

TRINITROPHENOL.

Ellis, Carleton L.: Experiments in connection with a method for the production of picric acid from chlorbenzol are described. In employing the dinitrochlorbenzol process, picric acid of high purity was obtained without resorting to crystallization after the preliminary preparation of three intermediates.—Chem. Eng. 1917, v. 25, p. 22–25.

Dehn, William M., and Ball, Alice A.: A report of colorimetric studies on picric acid and picrate solutions.—J. Am. Chem. Soc., 1917, v. 39, p. 1381–1392.

Folin, Otto, and Doisy, E. A.: Attention is called to the impurities found in picric acid, which render the latter unfit for use in the determination of creatine and creatinine in the urine.—J. Biol. Chem., 1917, v. 28, p. 349–356.

Castaigne and Desmoulières: A practical method for the detection of picric acid in the blood serum in cases of simulated icterus.—Ann. chim. analyt., 1917, v. 22, p. 29–30.

Frédoux, M.: A contribution to the estimation of picric acid and its derivatives in the urine, blood, and feces. A colorimetric method in which Le Mitouard's reagent is used is described.—Bull. Soc. pharm. Bordeaux, 1917, v. 55, p. 43–47.

Ganassini, Domenico: A contribution to the chemical diagnosis of simulated icterus, due to the ingestion of picric acid.—Arch. farmacol. sper., 1917, v. 24, p. 289–298.

Laporte, X.: A colorimetric method for the quantitative determination of picric acid and its derivatives in the body fluids.—Bull. Soc. pharm. Bordeaux, 1917, v. 55, p. 218–225.

Pecker, Henri: A method for the detection of picric acid in urine depends on the fact that picric or picramic acids, if present, give a red coloration when the urine is rendered ammoniacal and brought into contact with ferrous sulphate-tartaric acid solution.—J. pharm. et chim., 1917, v. 15, p. 70–74.

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Tixier, Leon: A description of a method for the identification of picric acid in the blood in case of feigned icterus. The method is based on the color change which takes place with methylene blue.—Bull. sc. pharmacol. 1917, v. 24, p. 155–159.

Saladini, Raffaele: A review of the methods for the detection of picric acid when used by malingerers for the production of pseudo icterus.—Arch. farmacol. sper. 1917, v. 24, p. 97–112.

Forni: A report of a fatal case of poisoning due to the ingestion of picric acid.—Rivista Ospedaliera, 1916, v. 6, p. 787–792, through Presse Medicale, 1917, v. 25, p. 504.

TRITICUM.

Dohme, A. R. L.: Several samples offered as couch grass were rejected because they were nonofficial varieties of *Agropyron*. Some samples also contained an excessive amount of stem.—Proc. N. W. D. A. 1917, p. 519.

TROCHISCI.

Roller, Emil: Formulas for sugar lozenges should not be given recognition in a modern pharmacopœia. Their preparation should be left to the confectioner. The next edition of the U. S. P. should, however, give recognition to the truly medicinal lozenges, such as "Sulphur and Cream of Tartar," "Brown Mixture," and "Brown Mixture and Sal Ammoniæ."—D.-A. Apoth.-Ztg. 1917, v. 38, p. 31.

TROCHISCI CARBONIS LIGNI, N. F.

Hommell, P. E.: The troches of charcoal can be improved by omitting the sugar and introducing some calcined magnesia or bicarbonate of soda. These lozenges are intended to be used as an absorbent and antiacid. The presence of sugar in them is therefore certainly contraindicated.—Proc. New Jersey Pharm. Assoc. 1917, p. 82–83.

TROCHISCI GAMBIR, N. F.

Hommell, P. E.: The troches of gambir are a pleasant astringent for throat and bowel troubles, but there is no demand for them, and I doubt if there ever will be.—Proc. New Jersey Pharm. Assoc. 1917, p. 82.

ULMUS.

Farwell, Oliver Atkins: "*Ulmus pubescens* Walter" is generally considered to apply to the species of elm described in the U. S. P. As this designation is 15 years older than *Ulmus fulva* Mx., it should be adopted.—Drug. Circ. 1917, v. 61, p. 175–176.

Patch, E. L.: The ash content of three samples of powdered elm bark examined ranged from 9 to 15 per cent. One of the samples showed the presence of foreign starch.—J. Am. Pharm. Assoc. 1917, v. 6, p. 409.

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UNGUENTA.

Asher, Philip: Processes for the assay of the ointments of belladonna, tannic acid, boracic acid, mercury, ammoniated mercury, mercury nitrate, iodine, iodoform, stramonium, sulphur, and zinc oxide should be given in the U. S. P.—Am. J. Pharm. 1917, v. 89, p. 175.

Woodruff, T. L.: The methods described are applicable to the analysis of lubricating greases and ointments. The determinations include those of mineral matter, moisture, other volatile matter, iodine absorption, rosin, saponifiable and unsaponifiable matter.—Chem. Analyst, 1917, v. 20, p. 8–11.

Cook E. Fullerton: Notes on the sanitary dispensing of ointments.—Apothecary, 1917, v. 14, No. 3, p. 16.

Roller, Emil: White petrolatum alone, or mixed with lanolin, should replace lard and suet in the preparation of the official ointments.—D.-A. Apoth.-Ztg. 1917, v. 38, p. 31.

Axelrad, S.: Notes on the preparation of cetyl alcohol for use as a substitute for lanolin in the preparation of ointments.—J. Ind. & Eng. Chem. 1917, v. 9, p. 1123.

Jaudon: A contribution to the study of pomades, with special reference to the choice of excipients.—Répert. pharm. 1917, v. 28, part 2, p. 194–198; see also P. Carles. p. 225–226, 324–327.

Linnett, W. N.: Some remarks on the use of hardened cottonseed oil as an ointment base.—Pract. Drug. 1917, v. 35, No. 2, p. 34.

Engelhardt, H.: A list of German substitutes for the common ointment bases with directions for preparing the same.—J. Am. Pharm. Assoc. 1917, v. 6, p. 56–59.

Spalding, C. G.: Descriptive notes on the parparation of ointments containing hydrocarbon greases.—Apothecary, 1917, v. 29, No. 7, p. 13–14.

Russell, H.: In a discussion of the need for selecting the proper ointment base from a therapeutical standpoint, the author cites methods for preparing the following ointments: Camphor and chloral, ammoniated mercury, resorcinol, and thymol iodide.—Drug. Circ. 1917, v. 61, p. 242.

Issoglio, Giovanni: Data showing the oxidizability number of ointments containing mercury and lead are given.—Giorn. farm. chim. 1917, v. 66, p. 273–278.

Hommell, P. E.: It is suggested that there be introduced into the N. F. an ointment of ichthyol of the following formula: Ichthyol, 200 gm.; hydrous wool fat, 250 gm.; petrolatum, 500 gm.—Proc. New Jersey Pharm. Assoc. 1917, p. 82.

UNGUENTUM AQUÆ ROSÆ.

A[illegible]: A discussion of a number of formulas for cold cream.—Am [illegible]917, v. 65, No. 8, p. 30.

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Elliot, Georges: The presence of 1 per cent of borax in the ointment of rose water of the Ph. Brit. is annoying when this ointment is intended to be used as a vehicle for salicylic acid, resorcin, lead oleate, calomel, zinc oxide, etc.—Pharm. J. 1917, v. 99, p. 283.

UNGUENTUM CALAMINÆ, N. F.

Anon.: The testimony of physicians has shown that calamine is superior to zinc carbonate or zinc oxide in the treatment of a certain type of sluggish ulcers. For this reason calamine ointment has been retained in the N. F., IV.—N. A. R. D. J. 1917, v. 25, p. 456.

UNGUENTUM DIACHYLON.

Beringer, George M.: In the formula for the preparation of diachylon ointment, white petrolatum has been substituted for olive oil. This is an improvement, as the use of the latter yielded an ointment which was too fluid in consistence.—Am. J. Pharm. 1917, v. 89, p. 353.

UNGUENTUM HYDRARGYRI.

Issoglio, G.: If mercurial ointment contains fat with a high oxidizability value (18 to 19), the use of rancid fat is indicated, while an extremely high value (74 to 100) points to the presence of oil of turpentine.—Ann. chim. applicata, 1917, v. 7, p. 187–199.

Pozen, M. A.: Of 26 samples of mercurial ointment examined, 13 were not of U. S. P. quality.—Rep. District of Columbia Health Off. 1917, p. 51.

Tice, William G.: Of six samples of mercurial ointment examined, three were below standard.—Rep. New Jersey Dept. Health, 1917, p. 62.

Wile, U. J., and Elliott, J. A.: A report of investigations to determine the mode of absorption of mercury in the inunction treatment of syphilis.—J. Am. M. Assoc. 1917, v. 68, p. 1024–1028.

UNGUENTUM HYDRARGYRI AMMONIATI.

Rippetoe, J. R.: The U. S. P. should give an assay method for determining the ammoniated mercury content of the ointment. Determination as the sulphide gives very good results.—Drug. Circ. 1917, v. 61, p. 502; J. Am. Pharm. Assoc. 1917, v. 6, p. 465.

Stout, Henry: The darkening of the color of the Ph. Brit. ointment of ammoniated mercury is very likely due to the benzoic acid which is present in the benzoated lard used in preparing the ointment. It is therefore thought that benzoated lard is not the best base for use in the preparation of this ointment.—Pharm. J. 1917, v. 98, p. 187.

UNGUENTUM HYDRARGYRI DILUTUM.

Baird, R. O.: All of the 16 samples of blue ointment assayed met the requirements of the U. S. P.—Bull. North Dakota Exper. Sta. F. Dept. 1917, v. 4, p. 392.

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Tice, William G.: Of 54 samples of diluted mercurial ointment examined, 25 were below standard.—Rep. New Jersey Dept. Health, 1917, p. 62.

UNGUENTUM HYDRARGYRI OXIDI FLAVI.

Rippetoe, J. R.: It is desirable that the U. S. P. give a method of assay for determining the yellow mercury oxide content of the ointment.—Drug. Circ. 1917, v. 61, p. 502; J. Am. Pharm. Assoc. 1917, v. 6, p. 465.

UNGUENTUM IODI.

Prusse, Francis J.: Notes on the preparation of iodine ointment.—Merck's Rep. 1916, v. 25, p. 77–78.

Dohme, A. R. L.: The committee on standards and deterioration of the American Drug Manufacturers' Association finds it desirable to determine the rate of deterioration of iodine ointment, and to discover a method for the prevention of the same.—Proc. Am. Drug Mfg. Assoc. 1917, p. 184.

Warren, L. E.: Analytical data relative to the iodine content and stability of U. S. P. and commercial iodine ointments are presented.—Am. J. Pharm. 1917, v. 89, p. 339–346.

Dohme, A. R. L.: Iodine ointment, when made by the official U. S. P. process calling for 4 per cent of available iodine, shows immediately after preparation only 3.5 per cent of available iodine. After several days the available iodine drops to 3 per cent. Samples several years old showed only 0.5 to 0.9 per cent of available iodine.—Proc. Am. Drug Mfg. Assoc. 1917, p. 183.

UNGUENTUM IODOFORMI.

Umney, John C.: The ointment of iodoform, Ph. Brit., becomes discolored on standing, owing to the liberation of free iodine. This is due to the use of lard in its preparation. To prevent the discoloration the addition of 1 per cent of potassium carbonate is suggested.—Pharm. J. 1917, v. 99, p. 213.

UNGUENTUM PHENOLIS.

Lascoff, J. Leon: The reduction in the phenol strength of the ointment of phenol (from 3 to 2.25 per cent) is justified, in that a portion of the phenol no longer separates on standing.—Am. Druggist, 1917, v. 65, No. 5, p. 26.

Roller, Emil: The changes in the U. S. P. formula for the preparation of ointment of phenol are no improvement over the old formula, since the phenol is not dissolved, but merely held mechanically in the form of fine particles, which unite when the ointment is brought in contact with water, and may thereby exert a caustic action upon the skin.—D.-A. Apoth.-Ztg. 1917, v. 38, p. 31.

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Dohme, A. R. L.: The committee on standards and deterioration of the American Drug Manufacturers' Association finds it desirable to determine the rate of deterioration of phenol ointment, and to discover a method for the prevention of the same.—Proc. Am. Drug Mfg. Assoc. 1917, p. 184.

UNGUENTUM PICIS COMPOSITUM, N. F.

Anon.: Notes on the preparation of compound tar ointment.—N. A. R. D. J. 1917, v. 23, p. 765.

UNGUENTUM PICIS LIQUIDÆ.

Elliot, George: Tar ointment forms a hard mass, resembling Burgundy pitch, when mixed with zinc oxide.—Chem. & Drug. 1917, v. 89, p. 1060.

UNGUENTUM SULPHURIS COMPOSITUM, N. F.

Anon.: A method of preparing compound sulphur ointment stated to be superior to that given in the N. F. is described.—N. A. R. D. J. 1917, v. 24, p. 17.

UNGUENTUM ZINCI OXIDI.

Austin, R. A.: Zinc oxide ointment is prepared by placing the zinc oxide on a strainer, consisting of two layers of cheesecloth, and pouring on the melted benzoinated lard heated to 135° F. The mixture is stirred with a spatula to force through the zinc oxide.—Drug. Circ. 1917, v. 61, p. 243.

Mueller, Ambrose: A description of a method for the preparation of zinc oxide ointment which is stated to be superior to that given in the U. S. P.—Meyer Bros. Drug. 1917, v. 38, p. 388.

Jackson, Frank A.: Of 186 samples of zinc ointment examined, 101, or 54.4 per cent, were not of U. S. P. standard.—Rep. Rhode Island F. & D. Com. 1916, p. 16.

Pozen, M. A.: Of 23 samples of zinc ointment examined, 14 did not meet the requirements of the U. S. P.—Rep. District of Columbia Health Off. 1917, p. 51.

URANII NITRAS.

Muller, Arno: From experiments it is concluded that the explosive properties of uranium nitrate are not due to the accidental presence of radium.—Chem. Ztg. 1917, v. 41, p. 439, through J. Chem. Soc. Lond. 1917, v. 112, part 2, p. 373.

MacNider, William DeB.: A consideration of the relative toxicity of uranium nitrate for animals of different ages.—J. Exper. Med. 1917, v. 26, p. 1–17.

Wilcox, Reynold W.: A discussion of the therapeutics of uranium nitrate.—Med. Rec. 1917, v. 92, p. 361–364.

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VALERIANA.

Rusby, H. H.: Much Japanese valerian root has been offered for import and has finally been accepted as genuine. There is still some doubt as to whether the Japanese plant is *Valeriana officinalis* or a distinct species; but it is of excellent odor and taste, very clean, and is in reality superior to the European form for medicinal purposes. It is very dark in color.—J. Am. Pharm. Assoc. 1917, v. 6, p. 415.

Rydén, Th.: A method for the assay of valerian root is based on the determination of its volatile acid content. Results obtained by the author's method gave 2.908 to 4.772 per cent of volatile acids for the rhizomes of *Valeriana officinalis* and 5.33 to 8.221 per cent for the rhizomes of *Valeriana excelsae* Poiret.—Svensk farm. Tidskr. 1917, v. 21, p. 525.

Söderberg, Ivar: By distillation with steam and extraction with ether, the rhizomes of *Valeriana officinalis* L. yielded 3.04 to 3.18 per cent of essential oil and the rhizomes of *Valeriana sambucifolia* Mik. gave 2.43 to 2.48 per cent.—Svensk farm. Tidskr. 1917, v. 21, p. 481–482.

Holste, Arnold: A discussion of the various applications of valerian and a comparison of its different synthetic and galenical products.—Deutsch. med. Wchnschr. 1916, v. 42, p. 599–560, through Chem. Abstr. 1917, v. 11, p. 3381.

VANILLA, N. F.

Anon.: A short account of the cultivation and preparation of vanilla for the market.—Perf. & Ess. Oil Rec. 1917, b. 8, p. 142–144.

Callmeyer, R. G.: General information is given relative to the vanillas imported from the Comores Islands.—Simmon's Spice Mill, 1917, v. 40, p. 950–953.

Carter, James G.: From data at hand it appears that the 1917 crop of vanilla in the French Islands of the South Indian Ocean will approximate 500 tons.—Com. Rep. 1917, No. 102, p. 418.

Rabak, Frank: A study of the effect of curing on the aromatic constituents of vanilla beans. A reprint.—Am. Perf. 1917, v. 12, p. 295–296.

Von Fellenberg: A colorimetric method for the evaluation of cinnamon, cassia and vanilla is described.—Am. Perf. 1917, v. 11, p. 324.

Anon.: Notice of judgment No. 4723 relates to the adulteration of vanilla. S. R. A.—Chem. 1917, p. 286.

VANILLINUM.

Issoglio, Giovanni: Methods for the preparation of vanillin are described and the forms of adulteration are discussed.—Giorn. him. 1917, v. 66, p. 121–126.

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Anon.: Notes on the synthetic preparation of vanillin, including a concise description of a method for preparing the same from eugenol.—Perf. & Ess. Oil Rec. 1917, v. 8, p. 149–150.

Estes, C.: A description of a colorimetric method for the determination of vanillin. The method depends on the quantitative production of a red-violet color by the action of an acid solution of mercuric nitrate.—J. Ind. & Eng. Chem. 1917, v. 9, p. 142.

Reid, E. Emmet: In describing work on the identification of phenols, the identification of vanillin by means of α-bromo-p-nitrotoluene is considered.—J. Am. Chem. Soc. 1917, v. 39, p. 304–309.

VERATRUM VIRIDE.

Scoville, Wilbur L.: An assay for veratrum viride should be introduced into the next Pharmacopoeia. If not, good reasons, based upon investigation, should be given for not doing so.—Am. Druggist, 1917, v. 65, No. 1, p. 26.

VERBASCI FOLIA, N. F.

Farwell, Oliver Atkins: Since the genus *Verbascum* contains 200 or more species of wide variation in physical, and probably in therapeutic properties, it appears to be more appropriate to limit the drug to *Verbascum thapsus*.—Drug. Circ. 1917, v. 61, p. 231.

VERBENA.

Dohme, A. R. L.: Two samples of blue vervain examined were rejected because they were composed of nonofficial species of verbena.—Proc. N. W. D. A. 1917, p. 519.

VIBURNUM OPULUS, N. F.

Rusby, H. H.: The folly of taking the action that was at one time recommended to the U. S. P. revision committee of defining cramp bark as the bark of *Acer spicatum*, on the ground that the genuine drug could not be obtained, has been demonstrated by the appearance on the market of rather abundant supplies of true *Viburnum opulus*.—J. Am. Pharm. Assoc. 1917, v. 6, p. 409.

Alsberg, C. L.: A survey of the *Viburnum* barks on the market showed that in most instances the bark of mountain maple (*Acer spicatum* Lam.) had been substituted for the true cramp bark (*Viburnum opulus* L.). Likewise, the preparations of *Viburnum opulus* L. on the market were, in large part, prepared from the bark of *Acer* species. S. R. A.—Chem. 1917, No. 20, p. 59.

Dohme, A. R. L.: *Acer spicatum* is still occasionally offered as true cramp bark.—Proc. N. W. D. A. 1917, p. 519.

St. John, B. H.: Descriptions of some color reactions obtained with the extract of *Acer spicatum* (false viburnum opulus, viburnum opulus U. S. P. VIII).—Am. J. Pharm. 1917, v. 89, p. 10–13.

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VIBURNUM PRUNIFOLIUM.

Rusby, H. H.: Attention may well be called here to the ill-advised endeavor of the Medical Council of the A. M. A. to discredit this valuable drug. Undoubtedly there have been many wild claims made for the therapeutic activity of viburnum on the part of manufacturers of proprietary preparations, but it is equally true that medical practice has been full of cases in which life has been saved by its judicious use.—J. Am. Pharm. Assoc. 1917, v. 6, p. 415.

Anon.: There is evidently a mistake in the new description of this drug, since it refers to the bark of the tree in general and not the bark of the root.—N. A. R. D. J. 1917, v. 23, p. 683.

Dohme, A. R. L.: Two lots of black haw examined were adulterated with 18 per cent of wood and earthy matter.—Proc. N. W. D. A. 1917, p. 519.

Roberts, J. G.: A 69-bag lot of black haw examined contained about 23 per cent of foreign matter, consisting of stems, roots and rootlets. Other shipments have contained as high as 50 per cent of stems.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 91.

VINA.

Beringer, George M.: The elimination of all wines from the Pharmacopœia was probably due to a misunderstanding of the requirements of the Brussels international protocol.—Am. J. Pharm. 1917, v. 89, p. 353.

Anon.: The Russian minister of the interior defines medicated wines as wines which, in addition to the usual component parts of wine, contain medicaments in solution in such quantity that the average therapeutic dose will not contain over 10 grams of alcohol.—Chem. & Drug. 1917, v. 89, p. 17.

Besson, A. A.: A report of researches on the determination of oxalic acid in wines.—Schweiz. Apoth.-Ztg. 1917, v. 55, p. 81–85.

VINUM CARNIS ET FERRI, N. F.

Snyder, J. P.: The N. F. gives lengthy tests for solid extract of beef, but gives no test for wine of beef and iron. The Internal Revenue Department requires that the protein content of wine of beef and iron must be at least 1.4 per cent.—J. Am. Pharm. Assoc. 1917, v. 6, p. 714.

Utech, P. Henry: The use of amber-colored bottles will inhibit the tendency of the wine of beef and iron to decompose. Decomposition is due to the effect of light and heat. These agencies bring about the reduction of the ferric salt to the ferrous condition and the oxidation of citric acid with the liberation of carbon dioxide.—Drug. Circ. 1917, v. 61, p. 397.

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VINUM IPECACUANHÆ, N. F.

Hommell, P. E.: The wine of ipecac is a most valuable preparation as an expectorant and diaphoretic to associate with the spirit of mindererus and nitrous ether for bronchial trouble in children. It should not be employed, however, as an emetic, as the alcohol which it contains defeats the operation of emesis.—Proc. New Jersey Pharm. Assoc. 1917, p. 81.

VINUM PEPSINI, N. F.

Messinger, M. Lester: A formula stated to be superior to that given in the N. F. for the preparation of wine of pepsin is given.—Apothecary, 1917, v. 14, No. 3, p. 22.

XANTHOXYLUM.

Farwell, Oliver Atkins: The proper spelling for this generic name is *Zanthoxylum*. Linneas used *Z* for the initial letter, but Miller changed it to *X*. The original spelling should be restored.—Drug. Circ. 1917, v. 61, p. 176.

Bocquillon, H.: Descriptions of the active principles of the different species of *Xanthoxylum*.—Répert. pharm. 1917, v. 28, part 2, p. 66–67, 226–228.

ZINCI ACETAS.

Rippetoe, J. R.: The U. S. P. assay method for zinc acetate is faulty, due to the fact that the addition of hot diluted nitric acid to the zinc sulphide liberates sulphur, which forms a gummy mass and occludes some of the zinc, thus giving a low figure. Dissolving the sulphide in dilute hydrochloric acid and precipitating as the carbonate, gives satisfactory results —Drug. Circ. 1917, v. 61, p. 502; J. Am. Pharm. Assoc. 1917, v. 6, p. 465.

ZINCI CHLORIDUM.

Sjostrom, F. W.: A volumetric method for the estimation of zinc in zinc chloride, nitrate, and sulphate. An excess of pure hydrogen dioxide solution is added to an alkaline solution of the zinc salt, and the excess of alkali titrated.—Ztschr. angew. Chem. 1916, v. 29, ref. 511, through J. Chem. Soc. Lond. 1917, v. 112, part 2, p. 153.

Boldt, H. J.: A note on the use of zinc chloride in the treatment of uterine hemorrhage.—J. Am. M. Assoc. 1917, v. 68, p. 832–833.

ZINCI OXIDUM.

Le Wall, Charles H.: It is asserted that 90 per cent of the zinc oxide on the market at the present time will not satisfy the U. S. P. test for the absence of heavy metals, and that in the majority of cases lead is present in an amount ranging from 0.1 to 0.5 per cent calculated as metallic lead. Two tests for the presence of lead, more

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satisfactory than that of the U. S. P., are described.—Am. J. Pharm. 1917, v. 89, p. 353–355.

Dohme, A. R. L.: Two samples of zinc oxide of American manufacture contained 0.34 per cent of lead, calculated as lead oxide.—Proc. N. W. D. A. 1917, p. 516.

Roberts, J. G.: Most of the lots of zinc oxide examined contained heavy metals in excess of the U. S. P. standard.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 92.

ZINCI PHENOLSULPHONAS.

Adanti, Guido: A detailed description of a volumetric method for the determination of zinc phenolsulphonate. The method is based on the liberation of C_6H_4 (OH) SO_3H by H_2SO_4, and the reaction of the former with a known amount of Br to form $C_6H_2Br_3$ (OH) and HBr. By determining the bromine which remains uncombined, the amount which enters into combination can be computed and the weight of the zinc phenolsulphonate calculated therefrom.—Boll. chim.-farm. 1917, v. 56, p. 317–318.

ZINCI SULPHAS.

Sjöstrom, F. W.: A volumetric method for the estimation of zinc in zinc chloride, nitrate, and sulphate. An excess of pure hydrogen dioxide solution is added to an alkaline solution of the zinc salt, and the excess of alkali titrated.—Ztschr. angew. Chem. 1916, v. 29, ref. 511, through J. Chem. Soc. Lond. 1917, v. 112, part 2, p. 153.

ZINCUM.

Baxter, G. P., and Grose, M. R.: A report of the revision of the atomic weight of zinc by the electrolytic determination of zinc in zinc bromide. The number found was 65.388.—Chem. News, 1917, v. 115, p. 6–8.

Dohme, A. R. L.: One lot of zinc (mossy), supposed to be arsenic free, when examined showed a trace of arsenic. It was considered U. S. P. zinc, as the amount of arsenic found was within the limit permitted for ordinary U. S. P. zinc. Another lot of zinc (small granules) tested contained considerably more arsenic than is permitted by the U. S. P.—Proc. N. W. D. A. 1917, p. 516.

Dohme, A. R. L.: The U. S. P. recommends a nickle dish previously coated electrolytically with silver or copper for the assay of zinc. Fully as good, if not better, results can be obtained in much less time by the use of a mercury cathode cup.—Proc. N. W. D. A. 1917, p. 503.

von Bichowsky, F. R.: Analytical data obtained in the titration of zinc by the electrometric method and the processes in common use are presented.—J. Ind. & Eng. Chem. 1917, v. 9, p. 668–671.

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Makao, Manzo: A comparative investigation of the electrolytic determination of zinc with the Fischer gauze electrode.—J. Pharm. Soc. Japan, 1917, No. 419, p. 29.

Fenner, G., and Rothschild: Notes on the estimation of zinc by Schaffner's method.—Ztschr. analyt. Chem. 1917, v. 56, p. 384–390, through J. Chem. Soc. Lond. 1917, v. 112, part 2, p. 580.

Hassreidter, V.: A discussion of the various modifications of Schaffner's method for the determination of zinc. The average results obtained are said to be trustworthy.—Ztschr. analyt. Chem. 1917, v. 56, p. 311–316, through J. Chem. Soc. Lond. 1917, v. 112, part 2, p. 509.

Hastings, J. H.: A description of Low's ferrocyanide method for the determination of zinc, with a brief discussion of the Waring method.—Chem. Abstr. 1917, v. 11, p. 1112.

Springer, J. W: An investigation of volumetric methods for the determination of zinc. A modification of the method proposed by L. Blum was found to be the most useful.—Ztschr. angew. Chem. 1917, v. 13, p. 173–174, through J. Soc. Chem. Ind. 1917, v. 36, p. 944.

ZINGIBER.

Farwell, Oliver Atkins: The proper source of ginger is *Zingiber Zingiber* (Linné) Karsten, instead of *Zingiber officinale* Roscoe.—Drug. Circ. 1917, v. 61, p. 176.

Anon.: Notes on the ginger industry of southern India.—Perf. & Ess. Oil Rec. 1917, v. 8, No. 9, p. 26.

Dohme, A. R. L.: Samples of Jamaica ginger examined within the past year were extremely poor, thin, and fibrous, with apparently too little resin.—Proc. N. W. D. A. 1917, p. 513.

Nomura, Hiroshi: Researches on the pungent principles of ginger. Part I. A new ketone, zingerone (4-hydroxy-3-methoxy-phenyl-ethyl methyl ketone) occurring in ginger.—J. Chem. Soc. Lond. 1917, v. 111, p. 769–776.

Lapworth, Arthur et al: A report of investigations undertaken for the purpose of determining the characteristics and decomposition products of Thresh's "gingerol."—J. Chem. Soc. Lond. 1917, v. 111, p. 777–798.

Nelson, E. K.: Some notes on the pungent principles of ginger and grains of paradise. Gingerol and paradol appear to be isomeric monomethyl ethers of the same dihydric phenol.—J. Am. Chem. Soc. 1917, v. 39, p. 1466–1469.

Grier, James: A review of papers by H. Nomura and A. Lapworth on the pungent principle of ginger published subsequent to those of Garnett and Grier.—Pharm. J. 1917, v. 99, p. 172–173, 205 and 216–217.

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Anon.: The oleoresin content of 3 samples of African ginger assayed was above standard. The oleoresin content of 3 samples of Jamaica ginger assayed was also above standard.—Proc. Pennsylvania Pharm. Assoc. 1917, p. 92.

Patch, E. L.: Several lots of ginger examined tested unusually high in alcohol extract, viz: 8, 9.5, 7.5, 10.25, 7.7, 6.5 and 7 per cent, respectively.—J. Am. Pharm. Assoc. 1917, v. 6, p. 410.

Street, John Phillips: The examination of 10 commercial samples of ginger gave the following result: Total ash, 4.01 to 6.51 per cent.—Rep. Connecticut Agric. Exper. Sta. 1917, p. 151–152.

Anon.: Notice of judgment No. 4517 relates to the adulteration of Jamaica ginger.—S. R. A.-Chem. 1917, p. 28.

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HYGIENIC LABORATORY BULLETINS OF THE PUBLIC HEALTH SERVICE.

The Hygienic Laboratory was established in New York, at the Marine Hospital on Staten Island, August, 1887. It was transferred to Washington, with quarters in the Butler Building, June 11, 1891, and a new laboratory building, located in Washington, was authorized by act of Congress March 3, 1901.

Of the bulletins published by the laboratory since its establishment, copies of the following are available for distribution and may be obtained without cost by applying to the Surgeon General, United States Public Health Service, Washington, D. C.

No. 2.—Formalin disinfection of baggage without apparatus. By M. J. Rosenau.

No. 43.—The standardization of tetanus antitoxin (an American unit established under authority of the act of July 1, 1902). By M. J. Rosenau and John F. Anderson.

No. 44.—Report No. 2 on the origin and prevalence of typhoid fever in the District of Columbia, 1907.—By M. J. Rosenau, L. L. Lumsden, and Joseph H. Kastle.

No. 45.—Further studies upon anaphylaxis. By M. J. Rosenau and John F. Anderson.

No. 46.—*Hepatozoon perniciosum* (n. g., n. sp.); a hæmogregarine pathogenic for white rats; with a description of the sexual cycle in the intermediate host, a mite (*lelaps echidnimus*). By W. W. Miller.

No. 50.—Further studies upon the phenomenon of anaphylaxis. By M. J. Rosenau and John F. Anderson.

No. 51.—Chemical tests for blood. By Joseph H. Kastle.

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TREASURY DEPARTMENT
UNITED STATES PUBLIC HEALTH SERVICE

HYGIENIC LABORATORY—BULLETIN No. 126
September, 1920

I. TRINITROTOLUENE POISONING—ITS NATURE, DIAGNOSIS, AND PREVENTION

By CARL VOEGTLIN, CHARLES W. HOOPER, and J. M. JOHNSON

II. THE TOXIC ACTION OF "PARAZOL"

By CARL VOEGTLIN, A. E. LIVINGSTON, and CHARLES W. HOOPER

III. MERCURY FULMINATE AS A SKIN IRRITANT

By A. E. LIVINGSTON

WASHINGTON
GOVERNMENT PRINTING OFFICE
1920

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CONTENTS.

	Page.
I. Trinitrotoluene poisoning, its nature, diagnosis, and prevention	7
Introduction	7
Experimental T. N. T. poisoning in animals	8
Plan of investigation	9
Discussion of results	12
(*a*) Symptomatology	12
(*b*) Paths of absorption of T. N. T	13
(*c*) Fate of T. N. T. in body	14
(*d*) Necropsy findings	16
(*e*) Pathogenesis of anemia and icterus	17
(*f*) Influence of diet	21
(*g*) Importance of impurities in crude T. N. T	21
Summary	22
Field investigation	23
Manufacture of high-explosive shells	23
Incidence of T. N. T. poisoning	24
Preventive measures	29
Absorption of T. N. T. by skin	29
Absorption of T. N. T. by lungs and gastrointestinal tract	32
Diet	33
Toxic jaundice and aplastic anemia	33
Summary	36
Acknowledgments	38
Bibliography	38
Appendix.	
1. Chemical preparation and physical properties of T. N. T. derivatives	41
2. Preparation of chemically pure 2, 4, 6, trinitrotoluene	49
3. Trinitrotoluene administered in animal experiments	49
4. Methods used in blood examinations	50
5. Urine examination	51
6. Histological examination of tissues	52
7. Acute T. N. T. poisoning. Effect of oxygen inhalation on cyanosis, incoordination and pulse rate	52
8. Chronic T. N. T. poisoning in dogs. Protocols and tables	57
9. Mechanism of the anemia. Perfusion and in vitro experiments	136
10. Examination of T. N. T. workers. Tables	138
11. Diet of T. N. T. workers	154
II. The toxic action of "Parazol"	183
Physical properties and chemical composition of parazol	183
Report on the chemical composition of parazol	183
Dermatitis produced by parazol and some of its constitutents	186
Eye lesions produced by parazol and its constituents	187
Systemic effects of crude parazol	188
Summary	190

Digitized by Google

Page.
III. Mercury fulminate as a skin irritant..... 203
Introduction..... 203
Preparation and physical properties..... 203
Dermatitis and systematic poisoning among workers..... 204
Experimental part..... 206
Dermatitis in rabbits..... 206
Mercury fulminate applied to human skin..... 207
Systemic effect in rabbits..... 208
Preventive measures..... 208
Summary..... 209

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I.—TRINITROTOLUENE POISONING—ITS NATURE, DIAGNOSIS, AND PREVENTION.

By CARL VOEGTLIN, CHARLES W. HOOPER, and J. M. JOHNSON.[1]

INTRODUCTION.

With the entrance of the United States into the World War, the prevention of poisoning among American munition workers presented a public health problem of considerable importance. Previous experience in other countries had demonstrated that the productiveness of munition plants was dependent, to a large extent, on the prevention of such poisoning. Protection of the health of thousands of workers engaged in this industry was also a matter of much concern. Our allies, Great Britain in particular, had fortunately given this matter serious thought and considerable scientific work had been done with a view to reducing the health hazards in munition plants.

The most important explosives used for the manufacture of shells belong to the group of nitro derivatives of aromatic hydrocarbons, aniline and phenol. Among these nitro-compounds, trinitrotoluene (commonly called T. N. T., triton, or trotyl) was predominantly used in this country and England on a very large scale. Inasmuch as the experience with this explosive in Great Britain had called attention to the serious health hazards connected with its manufacture, and especially its handling in the filling of high explosive shells, there appeared soon after the entry of the United States into the war several articles dealing with this subject.

In the Public Health Report of November 16, 1917, Surg. J. W. Schereschewsky, of the United States Public Health Service, gave an exposé of the practical aspects of the problem as ascertained by an inspection of the plants where T. N. T. was manufactured or used in the filling of shells.

W. G. Hudson (1917–18), medical director of the Du Pont Company, and Alice Hamilton (1918), of the United States Department of Labor, also contributed papers dealing with T. N. T. poisoning in factories in this country. H. S. Martland (1917) described the first fatal case of T. N. T. poisoning which had occurred in the United States.

Although no accurate statistics were available on the incidence of T. N. T. poisoning in this country, inspection of various factories

[1] Submitted for publication March, 1920.

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engaged in this industry had shown that the health of a considerable number of workers was affected by the constant contact with T. N. T. Being charged by Congress with the safeguarding of the health of the civil population, it became the duty of the United States Public Health Service to undertake an investigation of the best ways and means for the prevention of T. N. T. poisoning, inasmuch as it was evident that the available information was not adequate enough to lay down safe rules for this purpose. For instance, no satisfactory data were known as to the production and characteristics of T. N. T. poisoning in animals, data which were obviously needed to serve as a firm basis for the understanding of the nature, diagnosis, and prevention of T. N. T. poisoning in man. Accurate observations were also lacking in regard to the degree of contamination of factory air with T. N. T. under various conditions, data which are essential for purposes of proper ventilation of these plants. For these reasons the Hygienic Laboratory undertook a cooperative investigation, the Division of Chemistry concerning itself with (1) the determination of the vapor pressure of T. N. T. at various temperatures and the amount of T. N. T. present in the air of various parts of a shell-filling plant, and (2) the quantitative determination of T. N. T. or its derivatives in the urine. The Division of Pharmacology was charged with the study of the pharmacological aspects of the problem, with particular reference to (1) the elaboration of reliable and simple tests for the diagnosis of mild poisoning, (2) the investigation of the channels of absorption of the poison by the animal body, (3) the discovery of prophylactic methods, etc. It was in the nature of the problem that the practical aspects dealing with the recognition and prevention of T. N. T. poisoning should receive the major attention, although a number of very interesting observations were made which, as will be seen, have an important bearing on the subject of blood destruction and regeneration.

The data included in this report deal with the work done by the Division of Pharmacology. They are divided into two parts, the first one dealing with experimental T. N. T. poisoning as produced in dogs, and the second with the investigation of T. N. T. poisoning in a large shell-filling plant. The results obtained by the Division of Chemistry will be published elsewhere.

EXPERIMENTAL T. N. T. POISONING IN ANIMALS.

As previously stated, the literature contains very little satisfactory information concerning the production of typical T. N. T. poisoning in animals. R. P. White (1901), on the basis of a few experiments on cats and rabbits, considered T. N. T. "as not poisonous under ordinary use." Moore, Webster, and Wyon (1917) state that they were not successful in producing toxic symptoms in guinea pigs

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exposed for several weeks to T. N. T. fumes in factories, whereas kittens under similar conditions showed evidence of poisoning (cyanosis). The animal work of these investigators was largely confined to rabbits and guinea pigs, which were given one or a few doses, ranging from 10 to 9,000 mg. per kilo body weight. The British report, while containing extremely valuable information, does not include any really satisfactory information on T. N. T. poisoning in animals. This is due to the fact that the species of animals selected for the work happened to be highly resistant to the toxic action of T. N. T. It is, of course, possible to kill even a highly resistant animal with massive doses of the poison, but it is questionable as to whether the symptoms and pathological changes thus produced correspond to those found in T. N. T. workers who, according to clinical observers, must be exposed for at least four weeks to T. N. T.

During the progress of our work a brief abstract of the work of Kramer and Meierhof (1917–18) appeared, in which these authors report some experiments dealing with T. N. T. poison in dogs. They noted the following symptoms: Vomiting, diarrhea, depression, and weakness. Examination of the blood revealed the presence of a leucocytosis, polychromasia, and an increase in nucleated red blood cells. The necropsy findings were negative with exception of a moderate degree of central degeneration in the liver and an increase of blood pigment in the bone marrow, lymphnodes, and spleen. They called attention to the absence of any lesions which might explain the death of the animals particularly the absence of acute yellow atrophy of the liver.

GENERAL PLAN OF INVESTIGATION.

Preliminary experiments with guinea pigs and albino rats confirmed the previously noted statements of the British investigators that these animals are highly resistant to T. N. T. That the animals absorbed the poison was evident from the change in the color of the urine and the positive Webster test. In rats the urine contains a bright pink pigment after T. N. T. is given either by mouth or subcutaneously. The first few experiments with dogs and cats, however, showed that these animals develop the typical symptoms which are seen in T. N. T. poisoning in man. Dogs were finally chosen for this investigation as these animals seemed to be sensitive to T. N. T. and as they were of sufficiently large size to permit the frequent withdrawal of small quantities of blood for examination.

In view of the fact that T. N. T. poisoning in munition workers is essentially of a chronic nature requiring several weeks or even months for its full development, it was desirable to produce an analogous

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condition in dogs by the repeated administration of relatively small doses of T. N. T. over a long period of time. A small number of experiments dealt with a study of acute poisoning. For this purpose a single large dose (100 mg. per kilo) of the poison was given.

For the production of chronic poisoning the doses ranged from 5 to 33 mg. per kilo body weight given every day except on Sundays and holidays. The T. N. T. used in this investigation was obtained from various shell-filling plants and represented a product of average purity. A chemically pure T. N. T. was prepared for us by Dr. Marcus of this laboratory. In most of the experiments the poison was administered either by mouth in the form of gelatin capsules or subcutaneously dissolved in olive oil. A small number of animals received the T. N. T. in the form of fine dust directly into the lower air passages. For this purpose the animals were anesthetized. A small catheter was inserted through the trachea into the left bronchus and the fine T. N. T. dust was then blown into the lungs, this being followed by the immediate withdrawal of the catheter, care being taken that none of the poison would come into contact with the animal's mouth. A few animals received the poison dissolved in oil intraperitoneally.

The condition of the animals was carefully watched and the kind and severity of symptoms observed were recorded daily. A specimen of urine was secured each day (except Sundays) by means of catheterization and these urines were submitted to various tests for the presence of abnormal constituents, such as sugar, protein, bile pigment, T. N. T., and its derivatives.

Particular attention was also paid to changes in the blood in this condition. For this purpose the blood of each animal was carefully examined prior to and following the administration of the poison. In a considerable number of the animals a complete blood study was made including a quantitative estimation of the hemoglobin, the total blood volume, plasma volume, and pigment volume, the number and character of the red cells, a leucocyte and differential count, the number of reticulated and nucleated red cells, the coagulation time of the blood and the presence or absence of bile pigments and T. N. T. derivatives in the serum. The methods used for the examination of the blood changes will be found in the appendix.

In view of the fact that the work of Hunt (1910) and of Opie and Alford (1914) and Salant and Swanson (1918) had shown that the character of the diet has a marked influence on the toxicity of various substances, and as Hooper and Whipple (1918) have demonstrated that blood regeneration is materially influenced by the composition of the diet, it seemed important to study the effect of various diets on the course of the T. N. T. poisoning. Three diets were chosen for this purpose: (1) A bread and milk diet, being composed of

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approximately equal parts per weight of pasteurized milk and white bread, (2) a meat diet, consisting of medium fat beef with or without the addition of calcium phosphate, and (3) a mixed diet containing white bread, pasteurized milk, and medium fat beef in the proportion of 3, 3 to 1.

The relative proportions of protein, fat, and carbohydrates in these three diets were as follows:

	Protein.	Fat.	Carbohydrate.
Bread and milk	15	7	78
Mixed	20	14	66
Meat	45	65	0

These figures show that the bread and milk diet is rich in carbohydrates and relatively poor in fats and proteins. The meat diet, on the other hand, is rich in fat and protein, and the mixed diet occupies an intermediate position.

Inasmuch as the British report had called attention to the probable conversion of T. N. T. within the body into certain reduced compounds, particularly a hydroxylamin derivative, a number of reduction and oxidation products of T. N. T. were prepared and their pharmacological action, compared with that of T. N. T. The solubility of these compounds in oil and water was also determined. This phase of the work is of interest with respect to its bearing on the fate of T. N. T. in the body and the mechanism of the toxic action of the substance on the tissues and particularly the red-blood corpuscles.

A careful necropsy was made on all animals which died and all the tissues with the exception of the central nervous system were subjected to histological examination.

The results obtained are compiled in the tables and illustrated by the charts and drawings.

Explanation of charts.—The charts and their legends contain the essential information relating to and the results obtained by the experiments. The number and time of administration of the doses of T. N. T. are indicated by the arrows at the bottom of the charts. The figures immediately above represent the number of nucleated red cells per 200 white cells counted. The curves were obtained by plotting the initial value obtained before the animal received T. N. T. as 100 per cent. The curves therefore represent the percentage fluctuations and give a clear picture of the course of the poisoning as determined by the body weight and the blood changes. For the other details the reader is referred to the tables contained in the appendix.

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DISCUSSION.

(a) *Symptomatology.*—In munition workers various symptoms such as dermatitis, gastro-intestinal pain, constipation, bleeding from the nose, giddiness, cyanosis, breathlessness after slight exertion, anemia, and jaundice have been attributed to the toxic action of T. N. T. The symptom-complex varies with the individual. In the milder form of poisoning, which is spoken of as "minor T. N. T. sickness," there may be present cyanosis, dermatitis, nose bleeding, constipation and giddiness. The severer forms of poisoning have been divided into toxic jaundice and aplastic anemia.

An inspection of the charts, tables, and protocols will show that doses of T. N. T. ranging from 5 milligrams to 100 milligrams per kilo body weight produce a more or less severe grade of intoxication, the severity of the latter being somewhat dependent on the size of the dose. After the larger doses the animals show marked symptoms within a few hours, whereas the lowest dose used (5 milligrams per kilo) did not always lead to recognizable clinical manifestations.

The striking feature of T. N. T. poisoning in dogs is the fact that *individual susceptibility* plays a very important part. Certain animals receiving a fairly large dose may not show as marked symptoms as others receiving 50 to 75 per cent less T. N. T. This difference in individual susceptibility is very probably not due to differences in the rate of absorption of the poison, as T. N. T. is absorbed fairly rapidly. It is more likely that different individuals deal differently with the poison after the poison is absorbed, a point which will be dealt with later on.

Most of the animals developed within the first day after the administration of the T. N. T. a very pronounced *cyanosis*, a symptom which is very common in T. N. T. workers. The mucous membrane and tongue of the dogs assume a dark purplish color. This cyanosis was observed in some dogs as early as four hours after the administration of a fairly large dose. In a few animals which had received one large dose or repeated small doses this symptom was entirely lacking, in spite of the fact that these animals finally died from the effects of the poison (see dog 63, Table 28 and others). In animals receiving the poison over a long period of time the cyanosis usually cleared up after the first two weeks, giving place to an anemic appearance of the mucous membranes. At its height the cyanosis may be associated with a marked dyspnoea, and the blood always contains considerable methemoglobin and is chocolate-brown in color. Oxygen inhalation (see Appendix, p. 52) has no effect whatever on the cyanosis, a fact which proves that the latter is essentially due to the large amounts of methemoglobin of the blood.[2] It is, however, possible to lower the

[2] The ... moglobin formation is due to the reduction of T. N. T. to a hydroxylamine derivative, the lat... hemoglobin. Letsche (1912) Ztsch. physiol. chem., vol. 80, p. 419, has shown that h... rts oxyhemoglobin completely into methemoglobin.

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increased pulse rate and respiration observed in this condition by allowing the animal to breathe a mixture of air and oxygen.

In some of the experiments a very marked *incoordination* was noted which first appeared on the second or third day. The animal staggers and is apt to fall when attempting to walk down stairs. The incoordination is usually associated with a marked cyanosis and disappears in the later stages in chronic poisoning. It appears as if this symptom is due to a temporary functional abnormality of the cerebellar centers.

Vomiting and *salivation* were observed in a number of animals during the stage of acute intoxication. *Constipation* was sometimes noted, though as a rule the animals suffered from *diarrhea*. The *body weight* and nutrition were maintained in a satisfactory manner in a considerable number of experiments of long duration.

All animals developed an *anemia*, the principal features of which, and its causation, will be discussed separately. In six dogs a *marked icterus* was observed, this being preceded by the excretion of a considerable amount of bile pigment with the urine. Dermatitis occurs in T. N. T. workers, but was never observed in these animals.

Ulceration of the mucous membrane which was observed in the dogs on a bread and milk diet has no relation to T. N. T. poisoning, but is due to a dietary defect.

(*b*) *Paths of absorption of T. N. T.*—From a practical point of view it was important to determine by what channels T. N. T. can gain access to the blood and tissues. Under the conditions prevailing in the factories, the T. N. T. workers may come into contact with both T. N. T. vapor and dust, thus exposing the skin, the respiratory and gastro-intestinal tract to the poison. It was, therefore, necessary to determine whether these organs absorbed T. N. T.

Experiments which are not reported in detail have shown that dogs and cats which had received T. N. T. dust directly into the lower air passages developed a marked cyanosis within 12 hours and their urine revealed the presence of a T. N. T. derivative. T. N. T. is evidently very readily absorbed by the epithelial cells of the bronchi. On account of the probability of producing a pneumonia by this method of administration, no attempts were made to cause chronic poisoning in this way.

T. N. T. is also very readily absorbed from the gastro-intestinal tract when it is given in the form of gelatin capsules. As T. N. T. is very readily soluble in fat it might be expected that fat would favor its absorption. However, the comparison of the results obtained in animals fed either on a diet poor in fat (bread and milk) or on a fat-rich diet (fat meat) shows that the presence of a considerable amount of fat in the food does not favor the absorption in any way. Within six hours after the feeding of T. N. T. the urine

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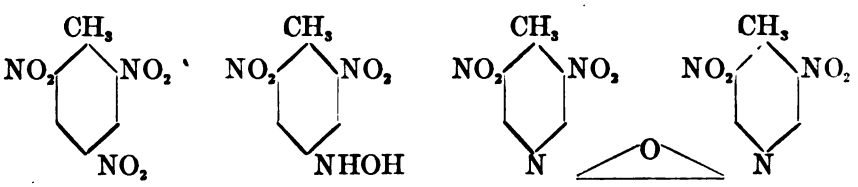
yields a positive test for the presence of a T. N. T. derivative (Webster test) and cyanosis, incoordination and dyspnoea are observed.

The poison is also absorbed with great ease when injected subcutaneously in the form of a 3 per cent solution in olive oil. These injections even when repeated daily over several weeks do not seem to lead to any local irritation at the site of injection. Kramer and Meierhof state that they have been able to produce T. N. T. poisoning in dogs with great regularity by means of skin inunction. We have not used this method, principally on account of the impossibility of ascertaining the amount of T. N. T. actually absorbed. T. N. T. is also readily absorbed from the peritoneal cavity. In conclusion, it is safe to say that T. N. T. is readily absorbed from the respiratory and gastro-intestinal tract, the subcutaneous tissue, the peritoneal cavity, and the intact skin.

(*c*) *Fate of T. N. T. in body.*—Moore and his associates of the British Medical Research Committee briefly state in their report that T. N. T. is reduced, within the animal body, to 2, 6 dinitro-4-hydroxylaminotoluene, which is readily converted into 2, 6-dinitro-4-azoxytoluene. The chemical relation of these three compounds is brought out by the following formulas:



The hydroxylamine derivative is then conjugated with glycuronic acid and excreted in this form in the urine. Although the announced paper on this subject has not appeared up to this date, it seemed of considerable interest to consider this question of the fate of T. N. T. From previous work on the metabolism products of toluene and aromatic nitro compounds, it is a priori possible that both oxidation and reduction might play a rôle in the modification of T. N. T. According to Nencki and Giacosa (1880) toluene is oxidized in the body to benzoic acid. Jaffe (1874) isolated from the urine of dogs which had received large doses of paranitrotoluene a substance which he identified as paranitrobenzoic acid, part of which was conjugated with glycocoll to nitrohippuric acid. Myer (1905) was able to isolate paraaminophenol from the urine of a case of nitrobenzene poisoning. He also confirms some older observations of Lewin, who claims that azoxybenzene occurs in the urine of animals poisoned with phenylhydroxylamine. Walko (1901) reports experiments which indicate that picric acid is reduced in the body to picramic acid.

That trinitrotoluene does not occur as such in the urine of T. N. T ers was shown by Moore and confirmed by us in the case of the

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urine of dogs poisoned with T. N. T. The so-called Webster test, which is used for this purpose, is based on the fact that an ethereal solution of T. N. T. assumes a purplish-red color after the addition of an alcoholic solution of potassium hydroxide. This test is always negative in the dog's urine if the fresh urine is directly extracted with ether. According to Webster it is essential to first acidify the urine with 20 per cent sulphuric acid before the ether extraction. The ether extract so obtained then yields a dark purplish-red color upon the addition of an alcoholic potash solution. When carried out in this latter way the test is usually positive in the extract obtained from the urine of dogs which had received T. N. T. indicating that unchanged T. N. T. is absent, but that a derivative giving the same test is present. This derivative according to Moore, is the above-mentioned hydroxylamine compound which has to be split off from its combination with glycuronic acid by the acid treatment. We found that the only derivative of T. N. T. which yields the same color as T. N. T. itself is the hydroxylamine compound (see p. 44, Appendix). It is therefore, very probable that the hydroxylamine compound is one of the metabolism products of T. N. T. We have repeatedly examined the feces of our animals for the presence of T. N. T., but were never able to get a positive Webster test. The bile, however, very often yields positive tests. Here also, as in the case of urine, it is necessary to add acid before carrying out the ether extraction, a fact which indicates that T. N. T. as such is not present and that therefore the test is probably due to the hydroxylamine derivative.

As to the quantity of the hydroxylamine compound which is excreted with the urine very little can be said, except that the method described by Elvove (1919) when applied to dog's urine accounts for only 9 to 42 per cent of the T. N. T. given to the animals.

An important fact which we wish to emphasize particularly is the absence of any relation between the urinary Webster test and the severity of the intoxication, as determined by the clinical symptoms and the grade of the anemia. The data presented in this report conclusively show that the Webster test may be persistently negative in spite of the presence of marked cyanosis and incoordination, and on the other hand it may be strongly positive in animals in which the symptoms are not especially pronounced.

We have also frequently made the observation that during the first month of chronic poisoning the urine of the dog yields a very marked Webster test, but that this test nearly always becomes negative in the later stages of poisoning, and this in spite of the fact that the animal still receives the poison and shows evidence of a progressing anemia. We believe that this is an indication of a change in the disposition of the poison by the body, in the sense that the hydroxyl-

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amin compound is further reduced to the mono or diamino derivative of T. N. T., substances which do not give the Webster test but possess the same pharmacological action as T. N. T.

It is also possible that part of the T. N. T. is oxidized to trinitrobenzoic acid, which would combine with glycocoll to form trinitrohippuric acid. We have been able to show that trinitrobenzoic acid, when given in doses of the same order as those required for the production of T. N. T. poisoning, has no evident effect on dogs. This substance is, to say the least, much less toxic than either T. N. T. or its reduction products. This difference in toxicity of T. N. T. and trinitrobenzoic acid is very likely due to the greater water solubility of the latter, a fact which favors its rapid removal from the body through the kidney. It is quite possible that the difference in the resistance of different individuals to T. N. T. poisoning may be explained by assuming that the more resistant animals oxidize the methyl group of T. N. T. more readily than the more susceptible individuals.

There remains much to be learned about the fate of T. N. T. and other aromatic nitro derivatives in the body. May it suffice here to state that the marked variation in the resistance to the poison may be easily explained on the basis of the assumption that the reactions involved in the transformation of T. N. T. in the body may differ both qualitatively and quantitatively in different animals of the same and different species.

Trinitrotoluene or some of its derivatives are retained in the tissues for a considerable time, as shown by the progressive anemia observed in dogs after a single dose of the poison and the slow recovery after the animal is taken off T. N. T. This retention of T. N. T. or its reduction products is probably due to the fact that these compounds are very insoluble in water, rendering their elimination with the urine difficult.

(*d*) *Necropsy findings.*—All of the animals that died from chronic T. N. T. poisoning were anemic and showed the following characteristic pathological changes which must be attributed to the action of this poison:

The endothelial phagocytes of the spleen pulp, bone marrow, and liver contained engulfed red cells and a varying amount of granular hemosiderin. These pigment granules were frequently as large as red corpuscles. The pigmentation was most striking in the spleen and bone marrow. (Fig. 6.) The liver pigment was usually confined to the swollen Kupffer cells within the liver capillaries. At times groups of hemosiderin-containing phagocytes were found about the portal spaces. The liver cells rarely contained even a small amount of finely granular hemosiderin. The mesenteric lymph glands occasionally contained a few hemosiderin-holding phagocytes.

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A mild icterus was found in 6 of the 39 animals. In these cases the subcutaneous fat and the intima of the aorta yielded a positive test for bile pigment.

A myeline degeneration of the sciatic nerve occurred in the majority of the animals in which this nerve was examined histologically, irrespective of diet.

In some of the dogs fed on medium fat beef the liver showed a definite fatty change chiefly confined to the liver cells surrounding the efferent veins. Hyaline necrosis was not found, although in a few cases small areas of focal necrosis were detected.

Animals sacrificed within a few days after administration of relatively large doses of T. N. T. showed a varying degree of splenic tumor. In these animals the endothelial phagocytes of the spleen pulp, bone marrow, and the Kupffer cells of the liver contained many engulfed red corpuscles apparently intact, and a small amount of granular hemosiderin. (See Figs. 2 and 3.)

A hyperplastic bone marrow was found in all of the animals except those sacrificed within a few days after the administration of the first dose.

In addition to the above changes a number of the animals with a complicating intercurrent infection showed broncho-pneumonia, acute nephritis, cloudy swelling of the liver, and splenic tumor. Two dogs of the mixed diet series and five dogs of the bread and milk diet series showed an extensive superficial ulceration of the oral mucous membrane, changes brought about by the deficient diet and not by T. N. T.

(*e*) *Pathogenesis of anemia and icterus.*—The salient feature of chronic T. N. T. poisoning in dogs is the anemia so constantly present and the mechanism of this red cell destruction. On reviewing the iterature on physiological blood destruction it is evident that a certain proportion of the erythrocytes are continuously broken down and replaced. Ashby (1917) showed that the length of life of transfused blood corpuscles in man is 30 days and more. As to the fate of the erythrocytes, present knowledge is still inadequate.

As long ago as 1901 Hunter stated that two different processes of blood destruction may be distinguished—one in which the red corpuscles are phagocytosed without loss of hemoglobin, the other in which the red corpuscles undergo hemolysis with the liberation of hemoglobin within the blood stream. The first process is characterized by a gradual decay of the red corpuscles while still circulating. They become spherical, deeper in color, and retain their hemoglobin until they are inclosed within the active cells of the spleen, or leucocytes of the blood, and are stored up within the spleen or in the capillaries of the liver. Within these cells the whole of the hemoglobin of the corpuscle is converted into hemosiderin. The pigment

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so formed is characterized generally by the varying size of its granules, some of which correspond in size to that of the original red corpuscles. In the liver, the pigment is found within the capillaries and never within the liver cells. The second process is marked by the liberation of hemoglobin from the red cell within the blood stream. The hemoglobin escapes from the corpuscle, either alone or in combination with the albuminous stroma. It is carried to the liver and is broken up by the liver cells.

Recently Rous and Robertson (1917) showed that a hemolytic process, in the ordinary sense of the term, at most plays a very minor part in normal blood destruction. They state that phagocytosis will not suffice as a general explanation of normal blood destruction and that the red corpuscles, in those species in which phagocytosis is negligible, are fragmented one by one, while still circulating, to a fine hemoglobin-containing dust which is eventually removed from the blood by the spleen, and under exceptional conditions by the bone marrow.

In certain anemias, on the other hand, such as those produced by hemolytic immune serum, and by certain poisonous substances (toluylenediamine, sodium oleate, phenylhydrazine, arseniated hydrogen, etc.), the destruction of the red corpuscles takes place by hemolysis within the circulating blood. The hemoglobin escapes from the corpuscles into the plasma and a hemoglobinemia ensues. If the concentration of hemoglobin in the plasma is great enough, it will escape through the kidneys into the urine. The liver cells contain an excess of hemosiderin in consequence of hemolysis, not of phagocytosis of red cells. The hemosiderin granules so arising are small and more or less uniform in size.

According to Pearce, Austin, and Eisenbrey (1912), hemoglobin escapes into the urine of normal dogs when the concentration of free hemoglobin in the blood plasma is approximately 0.06 of a gram of hemoglobin per kilo of body weight. The blood of the dog contains approximately 16 per cent of hemoglobin, so that it would require the hemolysis of the red corpuscles contained in only 4 c. c. to cause a hemoglobinuria in an animal weighing 10 kilos.

The anemia produced in dogs by T. N. T. is characterized by a very rapid destruction of the red corpuscles. The per cent of hemoglobin in the unit of blood diminishes. The pigment volume, representing the total amount of hemoglobin in the circulating blood at the time of the blood volume determinations, drops in certain animals to 50 per cent or less within 15 days, especially in those on a bread and milk diet. (See Chart 20 and Tables 20 to 24.) Coinciding with this decrease in pigment volume there is a marked diminution in the total blood volume corresponding roughly to the extent of the reduction of the red blood cell volume. This rapid blood destruction is

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not accompanied by the appearance of hemoglobin in the blood plasma or urine. In many cases there is also a complete absence of bile pigment in the blood plasma and urine. (See Chart 20, Dog 25, and Table 22.) The number of red corpuscles is usually markedly decreased. In a few cases, however, the erythrocytes have fragmented to such a degree that their actual number per cubic millimeter of blood is considerably increased above normal, while the total pigment volume and red blood cell volume show a very marked decrease. (See Charts 12, 15, 17, 20, 22, and 23.) Fragmentation of red cells has been most marked in dogs on a bread and milk diet. Anisocytosis, poikilocytosis, and polychromatophilia were common findings, the degree of such abnormalities usually corresponding to the degree of the anemia. The detailed examination for disintegrating red corpuscles in dogs acutely poisoned revealed the presence of considerable numbers of these cells in the blood, spleen, bone marrow, and liver. They were often small. Sometimes they were as large as and even larger than the normal red cell. Most of them were characterized by a translucent blisterlike elevation extending from a portion of the cell and having at times a somewhat irregular outline. The hemoglobin mass within these cells stained uniformly and deeper than the surrounding red corpuscles. Other cells were found in which the hemoglobin was apparently divided by a clear portion. (See Table 36 and Fig. 1.) Hemolyzing red corpuscles or red corpuscle shadows were not encountered.

Blood, aspirated from the external jugular vein within a few hours from animals given a moderate dose of T. N. T., is chocolate brown in color and contains large amounts of methemoglobin on spectroscopic examination. The methemoglobin is confined exclusively within the red corpuscles and does not occur in the plasma.

As stated above, in the necropsy findings, the spleen pulp, bone marrow, and, at times, the mesenteric lymph glands contain numerous large mononuclear phagocytes loaded with granular hemosiderin—some of the granules are as large as the red corpuscles—and in acute poisoning, especially, the phagocytes contain engulfed red corpuscles. The Kupffer cells of the liver are swollen and contain hemosiderin and red corpuscles. At times there are groups of hemosiderin containing phagocytes about the portal areas. The liver cells rarely contain hemosiderin.

A further important observation in determining the mechanism of the blood destruction is that T. N. T. does not produce hemolysis in vitro when added directly, or dissolved in olive oil, to defibrinated blood, citrated blood, or washed red corpuscles. However, from these experiments it is evident that T. N. T. is absorbed by the red corpuscles, since part of the oxyhemoglobin is changed into methemoglobin within 20 minutes at 37° C.

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On the basis of these observations the following explanation may be made of the mechanism responsible for the blood destruction in T. N. T. poisoning. *T. N. T. or some of its derivatives, being lipoid soluble, are absorbed by the red corpuscles and change part of the oxyhemoglobin into methemoglobin. Disintegration of the red corpuscles follows without the liberation of hemoglobin or methemoglobin into the blood plasma. The injured cells are then engulfed by the endothelial phagocytes of the spleen, of the bone marrow, of the lymph glands, to a certain extent, and by the endothelial Kupffer cells of the liver. The engulfed red cells are in turn broken down within the endothelial phagocytes with the formation of bile pigment and hemosiderin.*

The bile pigment which at times occurs in the urine of dogs poisoned with T. N. T. without the appearance of icterus can be easily explained when it is remembered that the dog's kidney excretes bile pigment very readily and that normally the blood plasma does not contain any bile pigment. A trace of bile pigment in the urine of normal dogs is commonly found, especially when the animals are constipated or during fasting periods. On the other hand, the threshold value of the human kidney for bile pigment is relatively high and the plasma contains a considerable amount of bile pigment before it appears in the urine. Gilbert and Herscher (1905) showed that the normal human serum contains from 25 to 35 milligrams of bilirubin per liter. Panton (1917) studied the blood of 100 munition workers exposed to T. N. T. and found that 20 per cent had an increase of bile pigment in the serum without its appearance in the urine. The increase of bile pigment found at times in the urine of poisoned dogs corresponds to the increase of bile pigment in the plasma of munition workers—probably brought about in either case by the increased destruction of red corpuscles by the endothelial phagocytes and the consequent formation of bile pigment within these phagocytes.

Six dogs out of 39 showed slight but definite clinical *icterus* of the mucous membrane of the mouth and conjunctiva accompanied by the appearance of bile pigment in the blood plasma and considerable amounts in the urine. In four of these dogs the icterus appeared several days before death. At necropsy the intima of the aorta and the subcutaneous fat were definitely bile stained and gave positive tests for bile pigment. The kidneys in two of the animals were normal. The slight fatty changes occasionally found in the liver can not be held responsible for the icterus. The bile in all four cases was very dark and viscous. (See protocols of Dogs 1 and 2 and Tables 15 and 17.) Special attention is called to the transient nature of the icterus observed in Dogs 15 and 38. (See Tables 9 and 27.) In these animals the icterus coincides with periods of very active blood de-

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struction. Furthermore, 5 out of the 6 animals that developed icterus were fed on meat, a diet which stimulates blood regeneration. On this diet the number of red corpuscles formed and possibly the number undergoing disintegration is greater than on a bread and milk diet, which, as already pointed out, is not as satisfactory for blood regeneration.

Possibly the icterus of these animals was of an obstructive type and hepatogenous in origin due primarily to the viscid bile which led to obstruction in the smaller bile ducts, with consequent absorption of the bile by the hepatic capillaries and without definite liver injury. Another possibility is a functional disturbance of the liver cells rendering them incapable of dealing with the bile pigment, as normally.

The primary rapid blood destruction observed in the dogs chronically poisoned is followed by an evident *blood regeneration*, as seen by the increase in the number of nucleated and reticulated[3] red corpuscles in the circulating blood and by a polymorphonuclear leucocytosis in most cases. In some animals blood regeneration temporarily overcame blood destruction, followed by a partial return to normal of the pigment volume and the total blood volume. (See Chart 1.) Then, unless the T. N. T. was discontinued, a recidivation followed the period of active blood regeneration which was associated with a gradual fall in the pigment volume and a reduction in the number of nucleated and reticulated red corpuscles.

All of the animals which had received the poison up until the time of death invariably showed a hyperplastic bone marrow at necropsy in spite of the presence of a very severe anæmia.

(*f*) *Influence of diet.*—On account of the considerable difference in the individual susceptibility to chronic T. N. T. poisoning, it is rather difficult to determine the exact influence of various diets on this intoxication. The number of experiments which would have to be carried out in order to obtain reliable data on this point would of necessity be very large. For this reason, the results obtained in this investigation, while not absolutely conclusive, are at least highly suggestive. It is seen that the animals on a mixed or meat diet seem to be more resistant than the dogs fed on bread and milk. (See Chart 20.) The animals belonging to this latter group as a rule show a more acute and severe anemia and die sooner. Evident exceptions to this rule are found in the experiments illustrated by Charts 21 and 22.

(*g*) *Importance of impurities in crude T. N. T.*—The T. N. T. used for the manufacture of high explosive shells is not a chemically

[3] An increased number of reticulated red corpuscles in the circulating blood is considered by Vogel and McCurdy (1913), Lee, Minot, and Vincent (1916), and Robertson (1917) to be very good evidence of increased activity of the erythroblastic system.

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pure substance, although it is a fairly pure product consisting of approximately 99 per cent 2, 4, 6 trinitrotoluene (T. N. T.).[4]

Various writers have attributed the toxic action of T. N. T. to the impurities contained therein, among which may be mentioned traces of β and γ trinitrotoluene and especially tetranitromethane.

The results reported in this paper clearly demonstrate that there is no qualitative nor quantitative difference in the pharmacological action of the ordinary T. N. T. obtained from shell-filling plants and chemically pure 2, 4, 6 trinitrotoluene. This latter substance was prepared by Dr. Marcus of this laboratory; the method of preparation is described in the appendix. Dr. Marcus also tried to isolate the impurities, but succeeded only in obtaining a few milligrams of β trinitrotoluene from 785 gms. of the commercial product. The fact is, therefore, well established that the toxic action of the commercial product is essentially due to 2, 4, 6 trinitrotoluene.

SUMMARY.

The results obtained in this work may be briefly summed up as follows:

A condition may be produced in dogs which in the most essential respects very closely resembles T. N. T. poisoning in the human. The symptoms observed are cyanosis, methemoglobinemia, choluria, dyspnea, incoordination, and salivation. An anemia appeared in all animals and in six a definite icterus was noted. The blood destruction is due to any injury of the red blood corpuscles leading to increased phagocytosis of these cells in the spleen, liver, and bone marrow (phagocytic anemia). Blood regeneration usually proceeds very slowly after the withdrawal of the poison. The icterus is caused primarily by the enormously increased breakdown of hemoglobin within the phagocytic cells of certain organs and in this respect is hematogenous in origin. Acute yellow atrophy of the liver was never observed in any of the animals.

The toxic action of T. N. T. is essentially due to 2, 4, 6 trinitrotoluene. T. N. T. is changed in the body and is not excreted as such. Reduction and oxidation may take part in this transformation. The reduction products have the same pharmacological action as T. N. T. Trinitrobenzoic acid, the only oxidation product studied, is much less toxic than either T. N. T. or its reduction products. A marked variation in individual and species susceptibility was observed which is probably dependent on the nature of the change undergone by T. N. T. in the body. A definite tolerance to the poison was never established.

The composition of the diet seems to be a factor influencing the susceptibility of the animals to T. N. T. poisoning.

[4] For literature relating to the manufacture of T. N. T., the reader is referred to Arthur Marshall's Explosives, J. & A. Churchill, London, England, and G. Smith's T. N. T. Manufacture, New York, Van Nostrand Company, 1918.

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FIELD INVESTIGATION.

The principal purpose of the field investigation was to apply the knowledge gained from the study of T. N. T. poisoning in animals to the conditions prevailing in the factories. This work was done in a large shell-filling plant employing from 7,000 to 8,000 workers and was made possible through the cooperation of both the management and the workers. The workers were employed in three shifts of eight hours each. The general sanitary conditions of this war settlement, such as housing, sewage disposal, water and food supply, were excellent. A hospital with a competent staff of physicians and nurses looked after the sick workers. On account of the high wages paid, the labor turnover was not large, a fact which made it possible to examine workers who had been exposed to T. N. T. for a long time. The workers of each factory unit were sometimes shifted from one job to another, but on the whole a considerable number were continuously exposed to T. N. T. The following brief remarks are intended to familiarize the reader with the conditions under which the T. N. T. worker is exposed to the poison.

MANUFACTURE OF HIGH EXPLOSIVE SHELLS.

The manufacture of high explosive shells varies with the type of explosive used. At the beginning of the war, T. N. T. was extensively used as the main charge. With the tremendously increased demand for these shells, it became necessary to supplement the deficient supply of T. N. T. by using a mixture of ammonium nitrate and T. N. T., commonly called amatol.

If T. N. T. alone is used, it is melted in large steam kettles at a temperature of about 85° C., and the molten explosive is then poured into the shells. Amatol is prepared by mixing three to four parts of dry ammonium nitrate with T. N. T. at a temperature of approximately 90° C. The mixture, while still warm, is pressed into the shells by machinery (extruding machine). In order to understand the process of filling, the following description of the various parts of a high explosive shell is here given.[5] The *shell* proper is made of hollow steel and fits snugly into the top of the cartridge. The *bursting charge* is contained in the shell and consists either of T. N. T. or amatol.

A circular opening in the top of the shell is threaded so as to allow the adapter and booster to be screwed down into it.

The *adapter* is a device holding a narrow tube which in turn contains a narrower tube. The two tubes together constitute the *booster*. The adapter and booster are loaded with a mixture of tetryl (tetranitroaniline) and T. N. T. The *fuse* which is loaded

[5] See Ordnance and Gunnery by Tshappat. Wiley & Sons. 1917.

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with a sensitive explosive (mercury fulminate) is inserted at the top of the shell. The fuse is not inserted at the filling plant, but is put in before the shell is fired. The bottom of medium and large caliber shells contain a mixture of T. N. T., ammonium nitrate and ammonium chloride. This mixture ("smokemix") is used to produce smoke for the purpose of range observations.

The method of filling the shells in use at the plant where this investigation was carried out was essentially the following: The empty shells were first painted in the empty-shell room. After this they pass to the pouring house containing three steam kettles in which the T. N. T. is melted. These kettles are provided with a hood connected with a vertical ventilating pipe which passes through the top of the roof. The hood has a window which permits the filling and emptying of the kettle. The workmen on this job are exposed to T. N. T. fumes and dust. The molten T. N. T. is poured into large ash cans, from which the shells are filled by means of hand dippers. The T. N. T. in the shells slowly crystallizes. The crust which is formed on the top is broken up in order to prevent cavity formation. This work is usually attended to by women. After all of the T. N. T. has crystallized the shells are put on trays and moved on rails to the finishing room, where the booster cavity is formed. This last process is done by pouring T. N. T. around a steel form inserted into the top of the shell. After cooling, the form is removed and the cavity is blown out with compressed air. The finishing room contains a steam kettle of the same construction as those in the pouring room. Finally the booster, containing the mixture of T. N. T. and tetryl, is inserted into the top of the shell. The loaded shells are transferred to the stenciling room, where they are labeled, weighed, and examined. From the stenciling room the shells pass to the magazine.

The booster plant is separated from the filling plant. The mixture of dry T. N. T. and tetryl is pressed into the booster by means of hydraulic presses.

Amatol was used as the main charge until two months before this work was begun.

INCIDENCE OF T. N. T. POISONING.

In the time at our disposal it was impossible to examine all T. N. T. workers in this plant. For this reason 237 workers were selected at random and subjected to a thorough examination, special attention being given to the presence or absence of clinical manifestations of T. N. T. poisoning, such as cyanosis, icterus, and dermatitis. A specimen of urine was obtained from each worker, and this was examined for the presence of T. N. T. derivatives (Webster test),

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bile pigment, and albumen. The blood was tested for its hemoglobin content by means of a Sahli hemoglobinometer standardized against a standard solution of hematin. The hemoglobin figures are therefore very reliable. The number and character of the red-blood cells was determined. A white-cell count and differential count was also made and the number of nucleated red cells per 200 white cells counted. Information as to the length of exposure to T. N. T and the type of work performed by each worker was obtained. The data pertaining to this work are compiled in the accompanying tables. Before proceeding to a discussion of these results it is desirable to review briefly the work of other investigators interested in this subject.

Livingstone-Learmoth and Cunningham (1916) relate their experiences in a shell-filling plant in Great Britain and call attention to the frequency of poisoning among 36 women workers as determined by clinical symptoms. They also report the blood and necropsy findings of a case of toxic jaundice. The blood in this case showed 4,400,000 red corpuscles, 9,320 white cells, 60 per cent hemoglobin, absence of methemoglobin and nucleated red cells, no abnormalities in white cells.

Panton (1917) examined 50 T. N. T. workers, some of whom had mild symptoms but were perfectly fit for work, with special reference to the blood changes. He stated that the red cells and hemoglobin were not adversely affected, with the exception of a slight degree of poikilocytosis. A moderate leucocytosis with a relative increase in the polynuclear neutrophils was noted in many cases. The blood serum often contained an abnormal amount of bile pigment. Panton furthermore examined 28 cases of toxic jaundice and 6 cases of so-called aplastic anemia. In the former group only 4 cases showed blood changes, these being characteristic of aplastic anemia. Panton suggests that moderate doses of T. N. T. might lead to a stimulation of the blood-forming organs.

Stewart (1917) reports 14 cases of toxic jaundice, in some of which the blood revealed an anemia of various grades. In 9 cases a neutrophil leucopenia with lymphocytosis was noted.

Smith (1918) examined 25 workers exposed to T. N. T. dust. A few showed slight cyanosis and complained of abdominal pains, but were otherwise perfectly fit for work. The lowest hemoglobin estimation was 75, and the red-cell count was never below 4,400,000. No abnormality was noted in the character of the red cells. Most of the cases showed a moderate leucocytosis and increase in polymorphonuclear neutrophils. The platelets appeared normal.

Harrington (1917) and Gregorson and Taylor (1918) also report a small number of cases of T. N. T. poisoning.

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Recently a paper appeared by Minot (1919) in which the blood changes found in 233 T. N. T. workers are reported in great detail, as follows:

Red cell abnormalities were found to be very frequent. The most interesting abnormality was the frequent finding of fragmented or fragmenting red cells which have a definite histologic character. These cells appear to afford evidence of a rapid increased destruction of the red cells. Evidence shows that distinct increases of these cells are to be looked on as a significant sign of a considerable degree of poisoning; and probably when they occur in large numbers, they indicate some degree of toxic jaundice. Among other red cell abnormalities noted were the following: Polychromatophilia occurred in 83 per cent of the cases, often to a marked degree. Howell-Jolly bodies, stippling and blasts were found, and increased numbers of reticulated red cells. The red cell count averaged in the mildest cases 4,500,000, and in the severest 3,800,000. It was found that there was usually a definite relationship between the total amount of red cell changes and the symptons. Methemoglobin or some form of changed hemoglobin is apparent in these cases.

The white blood cells do not furnish as much information concerning the worker's condition as do the red cells. Slightly increased white cell counts were common. The observations showed that an individual may become distinctly and severely poisoned with a normal, or an absolute or relative increased lymphocyte count, or with an increased or normal polymorphonuclear count. However, lymphocytosis is to be looked on as an undesirable sign, but does not necessarily indicate that significant poisoning will occur or is occurring, except when there is a leukopenia. Slight eosinophilia (more than 5 per cent) occurred in 10 per cent of the cases. It was more common in cases with slight symptoms than in those with marked.

The blood platelets were usually slightly increased. Their diminution was observed twice and in both cases there was a relative lymphocytosis. Such a condition should certainly be regarded as evidence of a severe effect on the marrow, indicating aplasia. Webster's test for changed trinitrotoluene in the urine was found to be less valuable than blood examination to indicate the worker's condition.

Minot does not give much information as to the change in hemoglobin content of the blood. The few hemoglobin estimations referred to were made by the Tallquist method, which is very unreliable.

In its final report (1918) the Health of Munitions Workers Committee of the British Ministry of Munitions makes the following recommendations concerning the detection of the milder forms of T. N. T. poisoning:

Care must be taken to avoid confusion with digestive disturbances due to other causes. Accounts given by patients may be unintentionally misleading. The yellow staining which normally occurs with T. N. T. can not be taken as in itself a sign of poisoning. The following points are the more important indications of T. N. T. poisoning:

(*a*) Pallor of face and an ashen gray color of the lips, tending to disappear if the worker becomes excited, as by medical examination. Sometimes the lips and tongue are purple in color; the tongue is generally free from fur.

(*b*) The character and situation of the stomach pains.

(*c*) The presence of constipation and stomach distention.

The literature, therefore, shows that with the exception of Minot all writers rely principally on the presence of clinical symptoms for the diagnosis of T. N. T. poisoning. We cannot share this view as

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our work has clearly shown that marked blood changes may be present in some workers in spite of the fact that they do not exhibit any cyanosis, pallor, or icterus. Table A reveals the significant fact that 72.5 per cent of the workers showed an anemia of various grades. These cases are grouped into three classes as follows: (1) Slight anemia, men with less than 84 per cent hemoglobin or a red cell count below 4,000,000, and women with less than 80 per cent hemoglobin or a red cell count below 3,700,000; (2) moderate anemia, workers with a hemoglobin content of 60–71 per cent; and (3) severe anemia, workers in whom the hemoglobin was below 60 per cent. According to Table A most of the anemia cases belong to the first and second groups and only one case revealed the presence of a severe anemia. The red cell count of the anemia cases is very often normal or even above normal. The red cells of these cases are, however, abnormal, showing anisocytosis and poikilocytosis. This relatively high number of red cells is due to fragmentation and proves that a red cell count alone, in the absence of a hemoglobin estimation, is a very unreliable diagnostic index. Nucleated red cells were found in the circulating blood in 18 per cent of the anemia cases.

As regards the leucocytes, 4 per cent of the cases with anemia showed a leucopenia, 22 per cent a leucocytosis (count above 10,000), and 49 per cent a relative lymphocytosis (mononuclears above 40 per cent).

Both sexes show approximately the same percentage of anemia cases, a fact which indicates that sex has no influence on the susceptibility to T. N. T. poisoning.

The same holds true in regard to the relation of the age of the workers to the susceptibility to anemia, as the latter appears in young, middle-aged, and old persons, the average age of the workers included in the three grades of anemia being approximately the same. (See Table B.) In passing, it should be mentioned, however, that the British reports refer to the greater susceptibility of persons under 18 years of age. We were unable to verify this observation as the factory regulations prohibited the employment of persons below 18 years of age.

It is furthermore seen from Table 37 that there is no consistent relation between the time of exposure and the susceptibility to anemia, a fact which is probably best explained by variations in the individual susceptibility of the workers to T. N. T. poisoning. It will be recalled that a very marked difference in individual susceptibility was also observed in dogs, and there is no reason to doubt that this may also occur in man. Moore attributes this difference in susceptibility to differences in the permeability of the skin to T. N. T. We believe that this factor may partly account for these differences, but not for all. It can not be denied that the skin of various indi-

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viduals shows a considerable variation in permeability to certain poisons. This was very well proven in the case of a number of war gases. It is to be kept in mind, however, that it was shown in the previous section of this bulletin that dogs exhibited a marked difference in susceptibility, even when differences in the absorption of T. N. T. were completely excluded. Under these conditions the variation in individual susceptibility is very likely due to differences in the methods of dealing with the poison on the part of the body, in the manner indicated in the experimental part.

Only 48 per cent of the anemia cases showed the presence of cyanosis of the lips. This observation is in conformity with the observations made on dogs with chronic T. N. T. poisoning. Here it was also shown that cyanosis of the oral mucous membrane is often absent in spite of the presence of a moderate to severe degree of anemia.

Pallor of the skin was noted in 39 per cent of our cases showing anemia.

A considerable number of the workers without anemia exhibit certain blood abnormalities and the presence of cyanosis or pallor. (See Table C.) This would indicate that T. N. T. is absorbed by these workers, but obviously not in sufficient quantity to produce an anemia or toxic jaundice. In these cases blood regeneration is able to overcome any increased blood destruction caused by the poison.

The urine of these workers never contained even traces of bile pigment and icterus was always absent. In no case did the urine contain sugar and only in a few a moderate amount of albumen was found. The urinary Webster test was made in a large number of cases and was nearly always positive. There was no relation between the intensity of the test and the anemia. The detailed account is therefore omitted. The Webster test has no diagnostic value beyond showing that T. N. T. is absorbed and excreted in a modified form. A few of the workers complained of shortness of breath and palpitation following slight exertion. Others complained of itching of the skin of the forearms and face, and in a few workers a typical papillar dermatitis was observed, such as illustrated by figure 9. The skin of the hands often shows a yellow staining due to T. N. T. The hair of some workers assumes a reddish yellow discoloration.

To sum up, it can be said that nearly three-fourths of the workers examined showed definite signs of poisoning. For the detection of poisoning the physician can not rely altogether on symptoms, but he should also make a blood examination. Much valuable information can especially be gained from an accurate hemoglobin estimation. A standardized Sahli hemoglobinometer is recommended for this purpose.

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PREVENTIVE MEASURES.

In the manufacture of T. N. T. and in the filling of shells with this substance, it is almost impossible to prevent all contact of the workers with this poison. A certain amount of vapor is always formed in the heating of T. N. T., and unless rigid precautions are taken this vapor escapes to some extent into the workrooms, where it condenses to a fine dust which settles slowly. It is also impossible to completely prevent the spilling of either the molten or solid explosive, with the result that the floor, machinery, and the outside of the shells are more or less contaminated with T. N. T. Hence the workers may absorb the poison through the skin or the poison may enter the body with the inspired air. In this latter case part of the substance may be swallowed and absorbed from the gastro-intestinal tract. On account of the absence of a method for the determination of the absolute amount of T. N. T. absorbed by the skin of the workers, it is impossible to estimate the relative importance of skin absorption and absorption by the respiratory and gastro-intestinal tracts. Moore and his colleagues are inclined to attribute all T. N. T. poisoning to skin absorption. This view is altogether too one-sided, as the estimation of the air contamination made by Prof. Phelps and Mr. Casselman of this laboratory plainly proves that under certain conditions the workers take in a considerable amount of the poison with the inspired air. For this reason it is safer to take the necessary precautions against both methods of absorption. The same position in regard to this matter is taken by the British Health of Munition Workers Committee in its final report.

ABSORPTION OF T. N. T. BY SKIN.

In view of the importance attached to skin absorption in the production of T. N. T. poisoning, it appeared desirable to determine the skin area actually exposed to the poison.

Several hundred workers, both men and women, were examined by testing the skin of the various parts of the body with alcoholic sodium hydroxide (Webster's reagent) and noting the intensity of the color so obtained. This varied from a very deep purple to a negative finding, and differed considerably on the same body surfaces in different individuals. As a general rule the reaction is most intense on the palms of the hands and about the ankle region. Next in line comes the dorsal surface of the hand, the wrist, foot below ankle, forearm, neck, and face in the order named. The reaction is rarely positive on other parts of the body.

The skin area exposed to T. N. T. in female workers was as a rule not as extensive as that of male workers, which is due to the fact that the former are more particular in wearing clean overalls, underwear,

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and gloves and that they bathe more frequently than the average male worker. This conclusion was reached from information volunteered by the workers, inspection of the change houses and living quarters.

The important practical point brought out by these tests is that the clothing and overalls protect the covered skin very efficiently against contact with the poison. The only exception in this respect concerns the ankle region. The poison gained access to this skin area on account of the fact that the overalls of these workers did not cover the upper part of the shoes, permitting T. N. T. dust to penetrate the stockings above the shoes. In order to avoid this the worker should be required to wear overalls which cover not only the legs but also the ankles.

The use of leather gloves seems to be of little protective value, as most of the workers remove these from time to time, allowing the inside of the gloves to become covered with T. N. T. Under these conditions skin absorption is probably favored instead of reduced, especially during the warmer seasons when excessive perspiration might aid it. The use of gloves should therefore be discouraged.

The British official reports refer also to the failure experienced in the use of skin varnishes in the prevention of skin absorption. In several cases varnishes gave very unsatisfactory results. Dr. George F. White of this laboratory has experimented with a shellac castor-oil varnish which appears fairly satisfactory for this purpose, but its trial in the factory was impracticable.

Further work was done in order to discover an inexpensive, harmless, and efficient skin wash which might prove satisfactory in removing T. N. T. from the skin of the workers before leaving the factory. It is obvious that such a skin wash might considerably reduce, possibly by two-thirds, the amount of T. N. T. absorbed by the skin, as the worker would no longer absorb the poison after he leaves the factory. The regulations in this plant required that the workers should wash their hands and faces very thoroughly with soap and water after stopping work, and they were also advised to take a shower bath. Excellent wash houses were available for this purpose, but the instructions were only partially carried out. It was furthermore found that soap and water does not remove all the T. N. T. from the skin even after thorough and repeated washing. Numerous experiments were then carried out to determine the solubility of T. N. T. in various solvents. The data referring to this work will be found in the appendix. The most promising solvent seemed to be a 10 per cent sodium sulphite solution.

The sulphite wash was tested out on T. N. T. workers in the following manner:

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Thirty-six workers volunteered for this experiment. They were asked to wash their hands and forearms very thoroughly first with soap and water and then with 10 per cent sodium sulphite in water. The presence or absence of T. N. T. on the skin previous to and after the washing with soap and the sulphite was determined by means of alcoholic sodium hydroxide (Webster's reagent). The results are illustrated by the following table:

No. of worker.	Webster test before washing.			Webster test after soap and water.			Webster test after sulphite.			Remarks.
	Hands.	Wrist.	Forearms.	Hands.	Wrist.	Forearms.	Hands.	Wrist.	Forearms.	
M. K. 471..	++++	+++	+	++	+	+Sl	.....	.....	.....	End of shift.
M. D. 647..	+++	++	+	++	+	+Sl	.....	.....	.....	Do.
L. I. 358...	.....	.....	.....	++	+	.....	.....	.....	.....	Do.
L. E. 543..	++++	+++	++	++	++	+	.....	.....	.....	Do.
M. K. 85...	++++	++	+	++	+	+Sl	.....	.....	.....	Do.
L. D. 314..	++++	++	+	++	+	+	.....	.....	.....	Do.
L. K. 401..	.....	.....	.....	++	+	.....	.....	.....	.....	Had been off T. N. T. 2 weeks. Worked on day of test.
L. K. 192..	++++	+++	+	+++	+	+Sl	.....	.....	.....	End of shift.
L. I. 562...	++++	++	+	+++	++	+	+Sl	+Sl	.....	Do.
L. I. 488...	+++	++	+	+	+Sl	.....	+Sl	.....	.....	Did not wash thoroughly.
L. I. 276...	++++	+++	++	++	++	+	+Sl	.....	.....	Do.
L. H. 615..	++++	+++	++	++	+	+Sl	.....	.....	.....	Do.
X.....	+++	++	+	++	+	+	+Sl	.....	.....	Do.
X.....	++++	+++	++	++	+	+	+Sl	.....	.....	Do.
L. I. 591...	.....	.....	.....	++	+	+	.....	.....	.....	Do.
L. I. 505...	.....	.....	.....	+++	++	+	.....	.....	.....	Do.

It is evident that washing of the skin with soap and water removes only a relatively small portion of T. N. T. After washing in the sodium sulphite, however, the test for T. N. T. becomes negative in practically all cases except where the washing had not been very thorough.

In order to gain some information as to the actual amount of T. N. T. removed by the sulphite wash, the following experiment was carried out.

Four T. N. T. workers were asked to thoroughly wash their hands and forearms with soap and water. After this they washed a second time in a liter of 10 per cent sodium sulphite, care being taken to prevent spilling of the solution. The sulphite solution assumed a dark red color and was analyzed for T. N. T. in the following manner. The solution was acidified with dilute sulphuric acid and extracted twice with ether. The ether extract was washed twice with distilled water and the ether evaporated to dryness. The crystalline residue, after drying to constant weight, weighed 148 mg. and consisted of T. N. T. It is, therefore, evident that at least 37 mg. were removed from the hands of each worker.

The workers who used the sulphite wash were enthusiastic over the efficiency of this chemical for the removal of T. N. T. and made

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inquiries as to where they could procure it. The reason for the great interest on the part of the workers is that the deep red color which appears on the skin after treatment with sulphite clearly proves to the worker the presence of T. N. T. on his skin, and the fact that the color passes into the solution visualizes the removal of the poison from the skin. There is no objection to the use of the sulphite solution for washing the face and neck as animal experiments have demonstrated that this solution has no injurious effect on either the skin or the eyes.

ABSORPTION OF T. N. T. BY LUNGS AND GASTRO-INTESTINAL TRACT.

In order to prevent as much as possible the absorption of T. N. T. by the lungs and gastro-intestinal tract, the workrooms should be properly ventilated and the process of manufacture should eliminate the possibility of air contamination with T. N. T. In the factory in which this work was carried out, three manipulations exposed the workers to badly contaminated air. First of all the melting of T. N. T. in the steam kettles led to an escape of a considerable amount of the vapor into the workroom as the kettle hoods were not provided with forced draft. The workmen engaged in melting were therefore breathing air more or less saturated with T. N. T. vapor, which according to the analyses reported by Prof. Phelps and Mr. Casselman [6] contains 0.006 mg. T. N. T. per liter. The worker would therefore breathe at least 16 mg. T. N. T. during 7½ hours. Another operation which leads to air contamination is the sweeping of the floors, which was done three times during the day while the workers were at work. The dust suspended in the air as a result of this operation is very light and settles slowly. As the result of the sweeping, each worker would breathe in approximately 9.1 mg. of T. N. T. during a day. The third objectionable operation consisted in blowing out the booster cavity with compressed air. This was done very frequently in the finishing room, and the persons on this job may take in 2 or 3 mg. of T. N. T. with each breath. These serious health hazards could easily be eliminated by the use of exhaust ventilators for the melting kettles and an appropriate vacuum system for the cleaning of floors and booster cavity.

The figures given in the report of Prof. Phelps and Mr. Casselman are convincing enough to emphasize the importance of preventing air contamination. The method used was ever so much more accurate than the one used by Moore and his colleagues, a fact which explains the higher values thus obtained.

As a further precaution, the workers should be urged to wash their hands thoroughly before eating their meal during the working hours.

The protective value of respirators has been tested out extensively in this country and abroad, and was found to be very unsatisfactory.

[6] The report by Prof. Phelps and Mr. Casselman will be published elsewhere.

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This investigation, therefore, clearly proves the necessity of guarding the worker against absorption of the poison by the skin as well as by the lungs and gastro-intestinal tract.

DIET.

In the first part of this bulletin attention was called to the relation between diet and T. N. T. poisoning. It was pointed out that dogs on a meat diet are more resistant to the action of T. N. T. than dogs fed on bread and milk. In view of this observation it was important to make inquiries concerning the diet of the workers.

The company operates two mess halls, one principally for women, the other for men. In both of these a fixed menu is served. There is also a "short-order" restaurant where the workers can choose their menu from a large variety of foods.

The portions served in these mess halls are fairly liberal. The menus for one week are to be found in the tables included in the Appendix. The menus vary but little from week to week, so that the ones given are fairly representative.

A relatively small number of the workers live in family cottages and procure their provisions from the company's commissary store.

It is evident that the diet of the workers is varied and that it includes a considerable amount of meat, vegetables, cereals, bread, butter, and fruits. It will be noted that very little milk and few eggs enter into the diet. A little condensed milk is served with coffee, tea, or cocoa.

The good quality of the diet consumed by the workers may be one of the factors which accounts for the evident absence of severe T. N. T. poisoning in this plant.

TOXIC JAUNDICE AND APLASTIC ANEMIA.

The first cases of toxic jaundice attributed to T. N. T. were reported in 1915 by the medical inspectors of factories to the British home office, which in turn issued instructions to physicians to report all such cases. According to O'Donovan (1918) there occurred in England, in 1916, 181 cases with 50 deaths; in 1917, 189 cases with 44 deaths. In addition there were reported during this period 14 cases of aplastic anemia, these cases being regarded as representatives of another extreme form of T. N. T. poisoning. No statistics are available as to the prevalence of these two conditions in the United States. Martland (1917) and Haythorn (1918) reported two fatal cases, giving also the pathological findings at necropsy. Hamilton (1917) reports 13 deaths from T. N. T. poisoning in the United States, but fails to state the nature of the clinical picture, whether toxic jaundice or aplastic anemia.

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It is very significant that the occurrence of toxic jaundice and aplastic anemia in T. N. T. workers is relatively rare when it is considered that Great Britain alone employed over 100,000 persons in the manufacture of munitions. It is also to be remembered that the diagnosis of toxic jaundice depends largely on the icterus, which of course is not characteristic of this condition only, and the association of the worker with T. N. T. Syphilitic icterus, or true yellow atrophy of the liver, may occur in T. N. T. workers and may thus lead to a diagnosis of toxic jaundice. The same holds true for aplastic anemia, a disease which also occurs in persons not exposed to T. N. T. It is therefore possible that the figures given by O'Donovan are somewhat too high.

The question naturally arises as to why most of the T. N. T. workers should be immune to toxic jaundice and aplastic anemia. The following considerations may assist in the solution of this problem. From the results obtained in the study of T. N. T. poisoning of dogs, it is evident that T. N. T. often causes the appearance of a very severe anemia. The bone marrow of these animals is hyperplastic without exception, and for this and other reasons the anemia as observed in these animals can not be regarded as a true aplastic anemia. The blood destruction was therefore attributed to a primary injury of the red cells leading to fragmentation and eventually to phagocytosis of the injured red cells by the phagocytic cells of certain organs. The examination of the T. N. T. workers has furthermore revealed the fact that a considerable number show a moderate anemia. Minot has also called attention to the fragmentation of the red cells in many T. N. T. workers. We therefore believe that the available evidence clearly shows that the mechanism of the blood destruction caused by T. N. T. is essentially the same in dogs and in man. Previous writers on this subject insist, however, that T. N. T. anemia is caused by the toxic action of T. N. T. or some of its derivatives on the hematopoietic organs, especially the bone marrow. Our data do not permit us to exclude this possibility altogether, although they do show that T. N. T. anemia is essentially a phagocytic anemia. The bone marrow was examined only in six cases of so-called aplastic anemia in T. N. T. workers. The marrow of the femur was described as gray in 1 case, fatty with pink spots in 2 cases, and pale pink in 2 cases. Turnbull (1917) from the microscopic examination of the bone marrow in one case claims that it showed a relative excess of erythroblastic activity and a decrease in the number of megalocaryocytes; numerous plasma cells and large phagocytes containing pycnotic nuclei, erythroblasts, erythrocytes, and iron-containing pigment. It is possible to conceive that in the later stages of the anemia the function of the bone marrow may be seriously depressed on account either of the oxygen deficiency or other metabolic abnor-

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malities resulting from the severe anemia, or as the result of the direct action of the poison on this organ. We believe, however, that these factors are of minor importance in the production of T. N. T. anemia.

As to T. N. T. icterus, the experimental work plainly shows that this condition may often occur in the absence of liver necrosis or atrophy in which case the icterus is probably due to the inability of the liver cells to excrete the increased amount of bile pigment resulting from the destruction of erythrocytes. Some of the cases of toxic jaundice reported by Panton (1917) may possibly be explained on this basis. The blood of these patients showed a normal hemoglobin content and red cell count. On account of these findings some writers explain this icterus as being primarily due to the injurious action of the poison on the liver cells, a view which is not necessarily correct as it is quite possible to conceive that T. N. T. may lead to a considerable increase in red cell destruction and consequently bile pigment formation without causing a reduction in the hemoglobin content or number of red blood cells. The hemoglobin content and red cell count is not an absolute index of the degree of blood destruction, as increased blood regeneration may temporarily compensate the increased disintegration of red cells. Some of Panton's cases which he observed for several weeks showed a gradual decrease in hemoglobin and the number of red cells, this finally resulting in the appearance of a severe anemia. It is very likely that in the early stages of the jaundice the increased blood destruction was compensated by regeneration, and that later on when this compensation failed, the anemia appeared.

It is therefore possible to attribute the icterus in some of the toxic jaundice cases to the increased blood destruction caused by T. N. T. In other cases, however, the icterus is associated with a marked reduction of liver dullness during life and at necropsy the liver shows extensive necrosis and atrophy, which according to Turnbull, Haythorn, and others can not be distinguished from acute yellow atrophy. The liver was examined in 30 of these cases and in all a greater or less degree of acute yellow or red atrophy was present. The liver cells of some areas were completely destroyed. Some observers also found a moderate amount of cirrhotic change. It is difficult to determine whether or not T. N. T. alone is responsible for these liver changes. We are rather inclined to explain these cases by assuming that certain preexisting pathological conditions affecting the functional capacity of the liver such as cirrhosis, syphilis, alcoholism, etc., may predispose some T. N. T. workers to toxic jaundice in an abnormal degree. Under these circumstances, it is possible to conceive that T. N. T. or its reduction products may exert a more deleterious action on the liver cells than in persons with a normal liver. This explanation would account for the fact

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that in numerous experiments with dogs it was impossible to produce even the slightest degree of liver atrophy, and this in spite of the fact that these animals are highly susceptible to necrosis of the liver when exposed to poisons with a more or less specific action on the organ, such as chloroform, phosphorus, and arsenicals.

The fact that toxic jaundice sometimes appears in T. N. T. workers several weeks after their removal from all contact with T. N. T., agrees with the observation made on dogs, viz, that T. N. T. is very slowly eliminated from the body, and therefore continues to exert its toxic action for a long period of time.

If the correctness of these considerations is taken for granted, the prevention of toxic jaundice and so-called aplastic anemia in T. N. T. workers should concern itself principally with the elimination of all persons with evidence of liver disease and anemia from contact with T. N. T. Moreover, all T. N. T. workers should be frequently examined by the factory physician, special attention being given to the occurrence of a slight icteric change of the conjunctiva or skin, the presence of this symptom being regarded as sufficient reason to put the individual on work where he is no longer exposed to T. N. T. An accurate hemoglobin estimatiom should also be made on each worker every week, or at least every two weeks. A nurse or specially trained laboratory assistant could easily attend to this work. Any workers with icterus or severe anemia should be admitted to a hospital. The treatment should consist first in the removing of all T. N. T. from the body surface by means of a 10 per cent sodium sulphite solution. The anemic patients should receive a nutritious diet containing a fair amount of fresh meat. The patients with jaundice should be treated with laxatives and should be fed on a meat-free diet containing milk and fresh vegetables.

The prognosis of cases with an extreme anemia is grave. A considerable number of cases with jaundice recover, although the recovery proceeds very slowly and requires six months or more. (See Crawford (1918) and Bower (1918).)

SUMMARY.

The principal results obtained in the field investigation are the following:

The examination of 237 T. N. T. workers in a shell-filling plant has shown that 72 per cent of these workers were anemic. This anemia exhibits the same features as the anemia observed in dogs poisoned with T. N. T., viz, a reduction in the hemoglobin percentage, the presence of anisocytosis and poikilocytosis, polychromatophilia, fragmentation of red cells and the appearance of nucleated and reticulated red cells in the circulating blood. The anemia may

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or may not be associated with a leucocytosis, leucopenia, or relative lymphocytosis.

Cyanosis, pallor, and dermatitis were frequently seen in these workers, and indicate that the poison is absorbed. However, the absence of these symptoms is not proof of the absence of poisoning. A marked anemia may exist without clinical symptoms.

Examination of the urine nearly always reveals the presence of a derivative of T. N. T. (hydroxylamine compound). The presence or absence of this substance in the urine, as determined by the Webster test, is of no prognostic value. The examination of the blood with particular reference to its hemoglobin content, the character of the red cells and the appearance of a slight icteric discoloration of the skin or conjunctivae is recommended as a reliable guide for the diagnosis of T. N. T. poisoning.

No cases of toxic jaundice or aplastic anemia were found among these workers. It is suggested that the so-called aplastic anemia observed in T. N. T. workers represents the final stage of the anemia so commonly found in persons exposed to T. N. T., and that in the earlier stages of poisoning the blood destruction is essentially due to the injury of the red cells which secondarily leads to phagocytosis of the injured cells by the spleen, liver, and bone marrow. In toxic jaundice the hemoglobin and red-cell count may be normal or reduced. In the first case blood regeneration probably compensates for blood destruction. The liver lesions found at necropsy may be due to a preexisting functional or histological abnormality of the liver cells which has been aggravated by the T. N. T. intoxication.

The poison may be absorbed through the skin, the lungs, or the gastro-intestinal tract. Means of prevention should be strictly observed. Skin contact and air contamination should be reduced to a minimum. The principal measures for skin protection should consist in wearing clean overalls and head dress, and in using sulphite solution for the removal of T. N. T. from the exposed skin surface before the worker leaves the factory. Personal cleanliness in working and in the care of the body should be emphasized. Gloves and respirators are of no value. There should be efficient ventilation of the workrooms; the floors, booster cavities, etc., should be cleaned by means of an induced draft. The workers should be instructed to eat a nutritious diet containing a fair amount of meat. They should be examined at least every week or two for the presence of clinical symptoms and anemia. Intermittent employment on T. N. T. work reduces the health hazard somewhat, but does not necessarily insure against poisoning because the system retains T. N. T. for a considerable length of time. Preliminary medical examination should insure, as nearly as possible, that no person is employed who shows the slightest evidence of liver disease or anemia.

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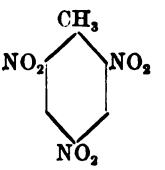
APPENDIX.

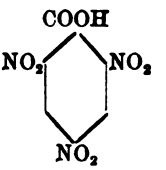
1. CHEMICAL PREPARATION AND PHYSICAL PROPERTIES OF DERIVATIVES OF TRINITROTOLUENE.

The derivatives prepared are not new but the methods of preparation have been altered in many cases and a complete study of the solubilities of all the compounds has been made. In some cases higher melting points than previously recorded have been obtained, indicating a greater degree of purity of the compounds.

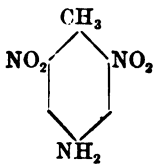
The following derivatives of 2, 4, 6-trinitro-toluene have been prepared and studied by us:



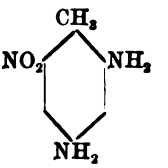
2, 4, 6-trinitro-toluene.



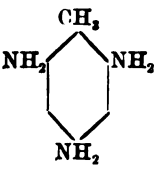
2, 4, 6-trinitro-benzoic acid.



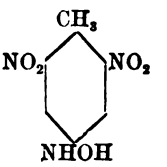
2, 6-dinitro-para toluidine.



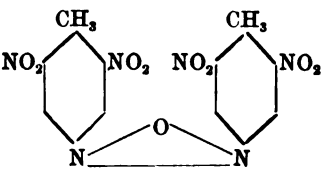
6 nitro-2, 4-diamino-toluene.



2, 4, 6-tri-amino-toluene.



2, 6-dinitro-4-hydroxylamino-toluene.



2, 6-dinitro-4-azoxytoluene.

TRINITRO-BENZOIC ACID.

This compound was prepared by Tiemann [1] by long heating of trinitro-toluene with fuming nitric acid in a sealed tube at 100° C. It was also prepared by warming 2, 4, 6-trinitro-toluene with 5 parts strong nitric acid and 10 parts concentrated sulphuric acid to 150–200° C.[2]

Gustav Lüttgen prepared it by the oxidation of trinitrotoluene in strong nitric acid with the addition of potassium chlorate.[3]

Trinitro-toluene was oxidized in concentrated sulphuric acid with anhydrous chromic acid at a temperature of 40–50° C.[4]

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[1] Ber. d. d. chem. Ges. 3, 224.
[2] Chem. Fabr. Griesheim, D. R. P. 77, 559.
[3] D. R. P. 226, 225.
[4] Chem. Fabr. Griesheim, D. R. P. 127, 325 (1901).

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Körner and Contardi [5] and M. Guia [6] also used chromic acid in sulphuric acid as the oxidizing agent for isomeric trinitrotoluenes. We found this last method to be the best for 2, 4, 6-trinitro-toluene, and with some variations in the procedure have prepared 2, 4, 6-trinitro-benzoic acid as follows: Forty grams 2, 4, 6-trinitro-toluene were suspended in 200 c. c. concentrated sulphuric acid in a flask under reflux condenser. The flask was placed in a bath kept at 60° C. and to the mixture in the flask there was gradually and carefully added 48 grams chromic acid. The heating was continued for several days. At the end of this time the whole was filtered on asbestos, the precipitate was washed with chloroform to remove unchanged trinitrotoluene, and then dissolved in ether, filtered, and recrystallized from an ether-chloroform mixture; 8.8 grams trinitrobenzoic acid were obtained m. p. 217° C., and upon further recrystallization 5.1 grams were obtained m. p. 228.7° C. (corr).

The sulphuric-chromic acid filtrate above was poured onto ice and the temperature kept below 35° C. This was then extracted with ether. The ether was distilled off and the residue purified with chloroform and recrystallized from chloroform and ether; 9.5 grams were obtained, and after further purification 7.1 gm. m. p. 228.3–229.4° C. (corr.).

Another way to recrystallize trinitrobenzoic acid is to dissolve in hot glacial acetic acid and add chloroform on cooling. The total yield of crude trinitrobenzoic acid was, therefore, 18.8 grams from 40 grams 2, 4, 6—trinitro-toluene.

Tiemann found the melting point of 2, 4, 6—trinitro-benzoic acid to be 190° C.; others gave it as 210° C. We, however, have found a much higher value—228.3–229.4° C. (corr.). This would indicate a higher state of purity of the product prepared by us.

2, 4, 6—trinitro-benzoic acid gives a bright red color with Webster's reagent (10 c. c. concentrated sodium hydroxide to 100 c. c. with alcohol).

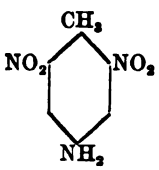
Analysis:

0.1868g Subs.: 0.2170g CO_2 and 0.0237g H_2O
0.2424g Subs.: 0.2820g CO_2 and 0.0326g H_2O
0.1500g Subs.: 20.3 c. c. moist nitrogen at 23.5° C. and 760.2 mm.
0.1500g Subs.: 20.58 c. c. moist nitrogen at 26° C. and 760.2 mm.
0.1500g Subs.: 20.4 c. c. moist nitrogen at 25° C. and 760.2 mm.
0.1500g Subs.: 20.4 c. c. moist nitrogen at 27° C. and 759.7 mm. $C_7H_3O_6N_3$

Found C, 31.68, 31.73	H, 1.42, 1.50	N, 15.2, 15.2, 15.2, 15.0.
Calc: C, 32.68	H, 1.18	N, 16.35.
$C_7H_3O_6N_3\frac{1}{2}H_2O$		
Calc: C, 31.57	H, 1.52	N, 15.80.

It would appear from the analysis that trinitro-benzoic acid contains one-half molecule water of crystallization. Upon drying it at 110° C. for several days to constant weight, the loss amounted to 1.63 per cent; $C_7H_3O_6N_3\frac{1}{2}H_2O$, calc: 3.39 per cent H_2O.

2, 6—dinitro-para-toluidine.



2, 6—dinitro-toluidine was prepared by Tiemann[7] by treatment of 2, 4, 6—trinitro-toluene with ammonium sulphide. The method was modified by Beilstein[8] and also by Holleman and Boseken.[9]

[5] Atti accad, Lincei, 23, 11, 464 (1914).
[6] Ibid.
[7] Ber. d. d. chem. Ges. 3, 218.
[8] Ber. d. d. chem. Ges. 13, 243.
[9] Rec. des. trav. chim. des Pays-Bas 16, 425.

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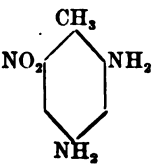
The method as followed by us and not varying essentially from above methods is: The 2, 4, 6—trinitro-toluene was suspended in alcohol and saturated ammonium sulphide solution (1.2 c. c. to 1.0 grams trinitro-toluene) gradually added with shaking and cooling. After allowing to stand several hours, the solution was diluted with water and filtered. The precipitate was recrystallized several times from alcohol or 40 per cent acetic acid. The preparation had a melting point of 171° C. (corr.).

2, 6—dinitro-para-toluidine gives a yellow color with Webster's reagent. A water solution of it when treated with a few drops of a very dilute potassium nitrite solution and a few drops of dilute sulphuric acid gives on standing a short while a beautiful bright red color.

6—nitro-toluylen-diamine (2, 4).



or 6-nitro 2, 4—diamino-toluene was prepared by Tiemann [10] by the reduction of 2, 4, 6—trinitro-toluene with an excess of alcoholic ammonium sulphide. We have made this compound in practically the same way, as follows: 8 grams trinitro-toluene were dissolved in hot alcohol, then before cooling an excess of saturated ammonium sulphide solution was added. Afterwards hydrogen sulphide gas was passed in for some time. The solution became very hot and the alcohol boiled slowly. After about two hours the solution was evaporated on a water bath to dryness. The residue was extracted twice with boiling water and filtered. By concentrating the water filtrate and recrystallizing from water 0.8 gram red crystals of 6—nitro 2, 4—diamino-toluene were obtained melting at 130° C. (uncorr.). The residue, insoluble in water, may be extracted with hot alcohol and 2, 6—dinitro-para-toluidine obtained.

6 nitro 2, 4-diamino-toluene gives a yellow color with Webster's reagent. It does not give any red color with potassium nitrite and sulphuric acid. It can be easily separated from the 2, 6-dinitro-para-toluidine as the latter compound is not very soluble in hot water and not very soluble in cold 10 per cent hydrochloric acid whereas the 6-nitro-2, 4-diamino-toluene is very soluble in both of these solvents.

2, 4, 6-triamino-toluene.

H. Weidel [11] reduced 2, 4, 6-trinitro-toluene with tin and hydrochloric acid. He did not isolate the triaminotoluene but carried it over to methyl-phloroglucin by heating with water. It was prepared by Palmer and Brenke [12] by reducing di-brom-trinitro-toluene with tin and hydrochloric acid. With some variations we have employed their method but starting with trinitrotoluene. Fifty grams of 2, 4, 6-trinitro-toluene were suspended in 500 c. c. 33 per cent hydrochloric acid, then cooled somewhat by placing the flask in a bath of melting ice. To the mixture of trinitro-toluene and acid there was gradually added 245 grams mossy tin. By keeping the mixture cool during the addition of the tin the reaction went smoothly. After all the trinitrotoluene had gone into solution, the liquid was filtered from the tin residue. The filtrate was then cooled to 0° C. and saturated with gaseous hydrochloric acid. White crystals which were formed were filtered on an asbestos mat in a Buchner funnel. The crystals were then dried on a porous plate, dissolved in water and decomposed with hydrogen sulphide repeatedly in order to remove all tin. The filtrate from the tin sulphide was concentrated in vacuo to a low volume. This concentrated

[10] Ber. d. d. chem. Ges. 3, 218. [11] Mon. F. Chem. 19, 224 (1898). [12] Ber. d. d. chem. Ges. 29, 1346 (1896.)

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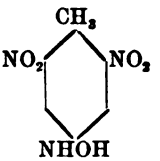
solution was then saturated with hydrochloric acid gas. The white precipitate was filtered off on an asbestos mat and dried on a porous plate, amounting to 28 grams. Five grams of the hydrochloride so obtained were dissolved in a very small amount of water and cooled to 0° C. To this there was added a slight excess of ice cold concentrated sodium hydroxide solution, care being taken not to add too much alkali as the free base is very soluble in an excess of sodium hydroxide. A yellow oil was formed which soon solidified. This was filtered off quickly, using suction. It was recrystallized from hot 95 per cent alcohol, then again from hot alcohol, cooling and adding ether. 1.1 grams were obtained m. p. 120° C. (uncorr.). This compound is very unstable and soon decomposes in the air.

Triaminotoluene gives no color with Webster's reagent. It gives a red color soon turning to brown precipitate when potassium nitrite and acid are added to it.

2, 6-dinitro-4-hydroxyl-amino-toluene.



2, 6-dinitro-hyrdoxyl-amino-toluene was first prepared by Cohen and Dakin.[13] They passed hydrogen sulphide gas into ice cold alcohol in which 2, 4, 6-trinitrotoluene was suspended and to which was added a very small amount of ammonia. However, they did not think that the nitro group in the 4 position was reduced but that the one in the 6 position was the group that had undergone reduction. They called the compound therefore, 2, 4-dinitro-6-tolyl-hydroxyl-amine. Cohen and McCandlish [14] discovered the true structure of 2, 6-dinitro-4-hydroxyl-amino-toluene. Anschütz and Zimmermann [15] also prepared this compound and found the melting point to be 135–136° C. whereas Cohen and Dakin reported it as 143° C.

We have prepared 2, 6-dinitro-4-hydroxyl-amino-toluene by the following procedure which is somewhat different from those referred to above: 50 grams, 2, 4, 6-trinitro-toluene were suspended in 250 c. c. alcohol, 1.0 c. c. concentrated ammonia water was added, and hydrogen sulphide gas was run in. The mixture was cooled with ice at first but later allowed to warm up during the addition of the gas, which was continued for about two hours. The insoluble portion was then filtered off using suction. The filtrate was poured into water. A bulky yellow precipitate was obtained, this was filtered off and dissolved in hot 95 per cent alcohol, bone charcoal was added, and the solution was filtered hot. The crystals obtained on cooling were filtered off and then recrystallized several times from benzene containing a very small amount of alcohol, and again recrystallized from alcohol. Finally 10.5 grams were obtained with a melting point of 135–136° C. (corr.). This agrees with that obtained by Anschütz and Zimmermann.

2, 6-dinitro-4-hydroxyl-amino-toluene gives a reddish purple color with Webster's reagent, very similar to that given by trinitrotoluene. With potassium nitrite and dilute sulphuric acid it gives a faint pink color, perhaps due to a trace of 2, 6-dinitro-4-amino-toluene present in the preparation and which was not removed by recrystallization.

[13] J. Chem. Soc. 81, 26 (1902). [14] J. Chem. Soc. 87, 1265 (1905). [15] Ber. d. d. chem. Ges. 48, 154 (1915).

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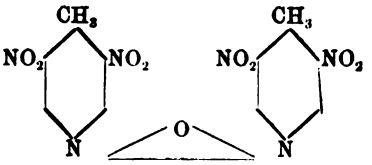
2, 6-dinitro-4-azoxy-toluene.



This compound was first made by Cohen and Dakin [16] by heating the 2, 6–dinitro-4-hydroxyl-amino toluene with strong acid or alkali. However, they thought that 2, 4-dinitro-6-amino-toluene had been produced. Later Cohen and McCandlish [17] discovered that this was incorrect, but stated that they had not been able to determine what this compound was. Anschütz and Zimmermann [18] made the substance and assigned the structure 2, 6-dinitro-4-azoxy-toluene to it. This is without doubt the correct formula.

Our preparation was made as follows: 5 grams of 2, 6-dinitro-4-hydroxyl-amino-toluene were boiled with 50 c. c. concentrated hydrochloric acid for 20 minutes, then cooled, poured into water, and filtered. The crude compound was recrystallized several times from benzene, also from chloroform-ether mixture and from acetone-ether mixture. Melting point, 218.1° C. (corr). Cohen and Dakin and Anschütz and Zimmermann found the melting point to be 212–213° C.

2, 6-dinitro-4-azoxy-toluene gives a blue color with Webster's reagent. It does not give any color with potassium nitrite solution and dilute sulphuric acid.

Analysis:

0.1317g Subs.: 0.1998g CO_2, 0.0340g H_2O.

0.1250g Subs.: 24.0 c. c. moist nitrogen at 29° C. and 749.6 mm.

0.1250g Subs.: 23.8 c. c. moist nitrogen at 27° C. and 759.7 mm.

0.125g Subs.: 23.8 c. c. moist nitrogen at 29° C. and 759.7 mm.

$C_{14}H_{10}N_6O_9$.

Calc.: C, 41.37; H, 2.48; N, 20.69.

Found: C, 41.38; H, 2.81; N, 20.7, 21.0, 20.8.

Table of melting points.

Substance.	Melting point.
2, 4, 6-T. N. T.	81–82° C. (corr.).
2, 4, 6-trinitro-benzoic acid	228.3–229.4° C. (corr.).
2, 6-dinitro-para-toluidine	171° C. (corr.).
6-nitro-toluylen-diamine (2, 4)	130° C. (uncorr.).
2, 6-dinitro-4-hydroxyl-amino-toluene	135–136° C. (corr.).
2, 6-dinitro-4-azoxy-toluene	218.1° C. (corr.).
2, 4, 6-triamino-toluene	120° C. (uncorr.).

Colors produced with Webster's reagent.

[5 per cent alcohol-soda.]

Substance.	Color.
2, 4, 6-T. N. T.	Reddish purple.
2, 4, 6-trinitro benzoic acid	Red.
2, 6-dinitro-paratoluidine	Yellow.
6-nitro-toluylen-diamine (2, 4)	Yellow.
2, 6-dinitro-4-hydroxylamino-toluene	Reddish purple.
2, 6-dinitro-4-azoxy-toluene	Blue.
2, 4, 6-triamino-toluene	Colorless.

[16] Jour. chem. Soc. 81, 26 (1902). [17] Jour. Chem. Soc. 87, 1265 (1905). [18] Ber. d. d. chem. Ges. 48, 154 (1915).

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Qualitative solubility table.

Solvent.	T. N. T.	Trinitro benzoic acid.	2, 6-dinitro-para-toluidine.	6-nitro-toluylendiamine (2, 4).	2, 6-dinitro-4-hydroxylamino-toluene.	2, 6-dinitro-4-azoxytoluene.	2, 4, 6-triaminotoluene.
Water	Insoluble	Soluble	Slightly soluble.	Soluble	Somewhat soluble, hot.	Insoluble	Soluble.
Cold, 10 per cent HCl.	do	do	do	do	Soluble	do	Do.
Hot, 10 per cent HCl.	do	do	Soluble	do	do	do	Do.
Ether	Soluble	do	do	Somewhat soluble.	do	do	Insoluble.
Alcohol	Somewhat soluble.	do	do	Soluble	do	do	Soluble, hot; slightly soluble, cold.
Methyl alcohol	Soluble	do	do	do	do	do	Soluble.
Chloroform	Very soluble.	Insoluble	Slightly soluble.	Slightly soluble.	do	Soluble, hot.	Insoluble.
Carbon tetrachloride.	Soluble	do	Insoluble	Insoluble	Insoluble	Insoluble	Do.
Acetone	Very soluble.	Soluble	Soluble	Soluble	Soluble	Soluble	Slightly soluble.
Benzene	Soluble	Soluble, hot.	do	Slightly soluble.	do	Soluble, hot.	Insoluble.
Carbon bisulphide.	Slightly soluble.	Insoluble	Somewhat soluble.	Insoluble	Insoluble	Insoluble	Do.
Petroleum ether	Insoluble	do	Insoluble	do	do	do	Do.
Ethyl acetate	Soluble	Soluble	Very soluble.	Somewhat soluble.	Very soluble.	Soluble	Do.
Glacial acetic acid	do	do	Soluble	Soluble	Soluble	Soluble, hot.	Soluble.
Amyl alcohol	do	do	Somewhat soluble.	Soluble, hot.	do	do	Soluble, hot; slightly soluble, cold.

SOLUBILITY OF T. N. T. AND DERIVATIVES IN 0.8 PER CENT SODIUM CHLORIDE AND IN OLIVE OIL.

Method for sodium chloride solution: A weighed amount of the substance was warmed up with a measured volume of the salt solution, then allowed to cool overnight to room temperature. It was then filtered into a weighed Gooch crucible, using filtrate to bring residue into the crucible. After drying in a vacuum desiccator over sulphuric acid the weighing was made. A blank was made and correction applied for the same amount of salt solution passed through a weighed Gooch crucible and dried.

For olive oil: A weighed amount of the substance was warmed up with a measured volume of olive oil, then allowed to cool to room temperature over night. It was then filtered into a weighed Gooch crucible and sucked as free of oil as possible after using the oil filtrate to wash in residues. The oil remaining in the asbestos felt was then washed out with 10 c. c. petroleum ether. A blank was run in each case and correction applied for the solubility of the substance in petroleum ether. A very small error is present in that the petroleum ether causes a slight precipitation of the substance which was held in solution by the slight amount of olive oil in the asbestos. This was not corrected.

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Solubility of T. N. T. and derivatives at room temperature.

IN 0.8 PER CENT SODIUM CHLORIDE SOLUTION.

Substance.	Amount used.	Amount solvent.	Amount dissolved.	Grams per 100 c. c.
	g.	*c. c.*	*g.*	
2, 6-dinitro-4-azoxy-toluene	0.200	10	0	0
2, 6-dinitro-hydroxylamino-toluene	.200	10	0	0
2, 6-dinitro-4-amino-toluene	.200	10	0	0
6-nitro-2, 4-diamino-toluene	.200	10	.0670	.67
2, 4, 6-trinitro-benzoic acid	1.000	10	.3028	3.03
2, 4, 6-T. N. T	.200	10	.0007	.007

IN OLIVE OIL.

2, 6-dinitro-4-azoxy-toluene	0.200	10	0.0708	0.70
2, 6-dinitro-4-hydroxylamino-toluene	.500	10	.3216	3.22
2, 6-dinitro-4-amino-toluene	.200	5	.0391	.78
6-nitro-2, 4-diamino-toluene	.200	5	.0356	.71
2, 4, 6-trinitro-benzoic acid	.500	5	.0504	1.01
2, 4, 6-T. N. T	1.000	5	A .0586 B .1012	1.60

Partition coefficient between oil and water.

Substance.	Ratio.	Coefficient.
2, 6-dinitro-4-azoxy-toluene	0: 0.70	∞
2, 6-dinitro-4-hydroxylamino-toluene	0: 3.22	∞
2, 6-dinitro-4-amino-toluene	0: 0.78	∞
6-nitro-2, 4-diamino-toluene	0.67: 0.71	0.94
2, 4, 6-trinitro-benzoic acid	3.03: 1.01	3.0
2, 4, 6-trinitro-toluene	0.007: 1.6	0.004

A study was made of the solubility of 2, 4, 6-trinitro-toluene in various aqueous salt solutions. The purpose of this was to find a suitable inorganic solvent for use in removing T. N. T. adhering to the skin of the workers. The following table shows that sodium hydrosulphite was the most effective, but its high cost precluded its use; therefore, sodium sulphite was recommended.

SOLUBILITY OF T. N. T. IN 10 PER CENT AQUEOUS SOLUTIONS AT ROOM TEMPERATURE.

Method: 0.200 g. finely powdered T. N. T. was warmed up with 100 c. c. of the solvent, then allowed to cool overnight to room temperature. The solution was then passed through a weighed Gooch crucible and washed with 80 c. c. distilled water. The crucible containing the undissolved T. N. T. was then dried in a vacuum desiccator over sulphuric acid. A blank was made and correction applied for the 80 c. c. distilled water used as wash.

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Solubility of T. N. T. in 10 per cent aqueous solutions at room temperature.

Solvent.	Amount T. N. T. used.	Amount dissolved by 100 c.c.	Average.
	g.		
Water	0.200	0.0087	0.0094
	.200	.0101	
Sodium sulphite	.200	.0781	.0828
	.200	.0875	
Sodium carbonate	.200	.0039	.0062
	.200	.0085	
Sodium bicarbonate	.200	.0110	.0093
	.200	.0075	
Sodium thiosulphate	.200	.0127	.0127
Ammonia water	.200	.0179	.0177
	.200	.0175	
Sodium sulphide	.200	.0475	.0518
	.200	.0561	
Ammonium sulphide	.200	.0613	.0622
	.200	.0631	
Sodium hydrosulphite	.200	.1281	.1288
	.200	.1295	
Sulphurous acid	.200	.0053	.0073
	.200	.0093	
Sodium bisulphite	.200	.0031	.0029
	.200	.0027	

A study was made of the solubility of T. N. T. in liquid soap solutions, as this soap contains a large amount of free alkali and would seem to offer good medium for use in the factories for the removal of T. N. T. from the hands of the employees.

SOLUBILITY OF T. N. T. IN SOAP SOLUTIONS.

Soap solutions: 5.0 c. c. commercial liquid soap was diluted up to 100 c. c. with water, a second solution was made by the dilution of 1.0 c. c. liquid soap to 100 c. c. with water.

Method: 0.200 g. of finely powdered T. N. T. was warmed up with 10 c. c. of the diluted soap solution then allowed to cool overnight. It was then filtered into a weighed Gooch crucible and filtrate used for washing small particles of T. N. T. into the crucible. The crucible was then dried in a vacuum desiccator over sulphuric acid and weighed. A blank was run by passing 10 c. c. of the same soap solution through a weighed Gooch crucible, drying in desiccator and weighing. The determinations at 50° C. were made by keeping the T. N. T. and the diluted soap solution at that temperature in a bath for 30 minutes, then passing it through a weighed Gooch crucible, drying and weighing as before.

Amount T. N. T. used.	Concentration soap solution.	Amount soap solution used.	Temperature.	Amount T. N. T. dissolved.	Grams per 100 c. c.	Average.
g.		c. c.	° C.			
0.200	5 c. c. to 100	10	50	0.0078	0.078	0.069
.200	5 c. c. to 100	10	50	.0060	.060	
.200	1.0 c. c. to 100	10	50	.0030	.030	.027
.200	1.0 c. c. to 100	10	50	.0023	.023	
.200	5. c. c. to 100	10	Room.	.0010	.010	
.200	1.0 c. c. to 100	10	Room.			
.200	1.0 c. c. to 100	10	Room.			

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2. THE PREPARATION OF CHEMICALLY PURE 2, 4, 6-TRINITROTOLUENE.

By JOSEPH K. MARCUS.

One hundred g. of toluene (Kahlbaum, B. P. 110.5°–111°) was nitrated with nitric and sulphuric acids by the two-stage process as described by E. J. Hoffman.[19] The crude product was washed with warm water to remove the acid, and recrystallized five times from an alcohol-benzene mixture containing by volume 10 per cent of benzene. The product of the fifth recrystallization was shown by its unaltered melting point to be a pure substance:

Product of—	Melting point (corr.).
First recrystallization	81.0°–81.9°
Second recrystallization	81.8°–82.2°
Third recrystallization	81.8°–82.1°
Fourth recrystallization	82.0°–82.3°
Fifth recrystallization	82.0°–82.3°

SOME PROPERTIES OF T. N. T.

The pure product consisted of large shining white blades with a greenish-yellow tinge. It was found necessary to store the crystals in amber-colored bottles, since exposure to the light resulted in decomposition, and was indicated by the bright yellow color which they quickly assumed. Direct exposure of the white crystals to a hot August sun resulted in their being colored golden brown within one hour.

T. N. T. gives very marked color reactions with alkali, the color varying in shade and in permanency according to the solvent in which the test is performed. In water solution aqueous KOH produces a rose-red color. In alcohol solution with alcoholic KOH an intense purple color results. Likewise in ether solution with alcoholic KOH an intense purple is formed, but unlike the results with alcohol alone the characteristic purple color very quickly changes to a brown.

3. TRINITROTOLUENE ADMINISTERED IN ANIMAL EXPERIMENTS.

T. N. T. (No. 1 crude) obtained from Bethlehem Steel Co. Used for shell loading. Melting point 80+° C. Light yellow, small crystals.

T. N. T. (No. 2 crude) obtained from Du Pont Co. Used in shell loading plant. Melting point 80.6 to 81.6° C. Yellowish brown, small crystals.

T. N. T. (No. 3 pure) synthetic. Prepared from chemically pure toluene. Recrystallized from alcohol five times. Melting point 82–82.3° C. Yellowish white, large needles.

T. N. T. (No. 4 crude) obtained from Du Pont Co. Used for filling shells. Melting point 81.6±° C.

T. N. T. (No. 5 pure) prepared from sample No. 2. Recrystallized from alcohol and benzene four times. Melting point 82.3 to 82.6° C. Yellowish white, large crystals.

T. N. T. (No. 6 crude) obtained from Du Pont Co. Used for filling shells.

T. N. T. (No. 7 pure) prepared from sample No. 2. Recrystallized from alcohol and benzene and from chloroform three times. Melting point 81.4° C. Yellowish white needles.

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[19] E. J. Hoffman, Bureau of Mines, Technical Paper, No. 146, "Nitration of Toluene."

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4. METHODS USED IN BLOOD EXAMINATIONS.

Hemoglobin determination.—The colorimetric method used in all of the animal experiments was devised in this laboratory and has been in routine use since May, 1918. Coincidently, the method was published by Cohen and Smith (1919). It is a modification of the Sahli-Palmer method and should be designated as such. The general technique is the same as that used by Palmer (1918) and the standard solution is acid hematin as in the Sahli method. Blood aspirated from the external jugular vein was used for all determinations. A 1 per cent solution of blood is made by drawing 0.1 c. c. into a special pipette, made of millimeter glass tubing and calibrated, and transferring into 9.9 c. c. of 0.1 N hydrochloric acid. This solution is allowed to stand over night at room temperature and then it is compared in a Duboscq colorimeter with a standard acid hematin solution. The standard acid hematin solution is prepared from defibrinated dog blood. The hemaglobin content of this blood is determined by the Van Slyke gasometric method (1918). The defibrinated blood is then diluted with 0.1 N hydrochloric acid to make a 20 per cent solution of a blood with an oxygen capacity of 18.5 volumes per cent which contains approximately 14 gm. hemoglobin per 100 c. c. A drop of caprylic alcohol is added to prevent foaming. The 20 per cent solution of blood is thoroughly mixed and stored in a dark colored bottle, cork-stoppered, containing a few glass beads to facilitate later mixing. A small amount of chloroform is added to prevent the growth of molds. The cork is sealed in and the solution kept in the cold room. Such a solution will keep for many months without deterioration. Five c. c. of this 20 per cent blood solution made up to 100 c. c. with 0.1 N hydrochloric acid constitutes the 1 per cent standard for routine use in the colorimeter. This standard should be made up at least once a week. The accuracy of this method is within 1 per cent. The *Sahli hemoglobinometer* standardized against blood having an oxygen capacity of 18.5 volumes per cent was used for the hemoglobin determinations in the field investigations.

Blood counts.—The red and white cell counts and the differential white cell counts were made from blood aspirated from the external jugular vein in the animal experiments. In the field investigations the blood was taken from the lobe of the ear. The number of *nucleated red corpuscles* seen in differentially counting 200 white cells was recorded.

Reticulated red corpuscles.—A saturated stock solution of brilliant cresyl blue was made up in normal salt and a crystal of thymol added to prevent the growth of molds. Before making a reticulated cell count a small quantity of stock solution was diluted 100 times with normal salt solution. A drop of this solution was placed on a glass slide and then a very small drop of blood, on the tip of a two-millimeter glass rod, was added and thoroughly mixed. A cover glass was then placed over the drop and sealed with vaseline. After an interval of 10 minutes the number of reticulated cells per 1,000 red corpuscles was recorded.

Blood volume.—The method used for the determination of plasma and blood volume has been described recently by Hooper, Smith, Belt, and Whipple (1920). The principle underlying this method is the same as that of Keith, Rowntree, and Geraghty (1915). A weighed amount of a dye "brilliant vital red" [20] is introduced directly into the circulation and after a four-minute interval the dilution of the dye in the plasma is determined colorimetrically by comparison with a standard mixture of dye and serum. Blood is also withdrawn into an accurately graduated centrifuge tube containing a measured amount of an isotonic sodium oxalate solution and, after centrifuging at high speed, the relative proportion of erythrocytes and plasma are noted. The *plasma volume*, *total blood volume*, and *red corpuscle volume* are calculated from the percentage concentration of the dye in the plasma and the relative percentage

[20] This dye is known commercially under the name Brilliant Congo Red or Azidine Scarlet B. E. P. 6987 and 1887 and D. R. P. 41095.

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of plasma and red corpuscles in the circulating blood. The *pigment volume* is obtained by multiplying the total blood volume by the per cent hemoglobin and represents the total amount of hemoglobin in the circulating blood at the time of the blood volume determination. The *red cell hematocrit* is the relative percentage of red corpuscles to plasma in the circulating blood.

For an entire quantitative blood examination approximately 35 c. c. of blood is withdrawn every two weeks. This amount is very small when compared to the large volume of circulating blood and does not add any secondary anemia factors to complicate the blood picture in T. N. T. poisoning.

In the preparation of charts the initial blood examinations or the average of the blood examinations, made before the administration of T. N. T., were considered 100 per cent for the animal. The blood examinations following the administration were plotted directly in per cent of the original examination. The detailed figures have been recorded in the corresponding tables.

Methemoglobin in red corpuscles, plasma, and urine.—The plasma and urine were examined spectroscopically. The red corpuscles were first laked with distilled water and then examined. When methemoglobin was present it was always converted into hemoglobin by the addition of concentrated ammonium sulphide and then oxidized into oxyhemoglobin by shaking with air.

Bile pigment in the plasma.—The method described by Hooper and Whipple (1916) and Gmelin's test were used.

Webster's reaction for T. N. T. in the plasma.—Five c. c. amyl alcohol were added to 5 c. c. plasma. The mixture was then made definitely alkaline with 0.1 N sodium hydrate solution, thoroughly shaken, and allowed to stand at room temperature over night. If a red ring formed at the junction of the plasma and amyl alcohol, the test was considered positive.

5. URINE EXAMINATION.

Bile pigment.—The method used for the dog urine is a modification of Huppert's reaction. Five c. c. of filtered urine is made alkaline with a saturated solution of sodium carbonate and slowly mixed with an excess of a 10 per cent solution of calcium chloride. The precipitate is filtered off and washed several times with distilled water. It is finally dissolved in 10 c. c. of a warmed mixture of nitric, hydrochloric acid and alcohol (ethyl alcohol, 95 per cent 100 c. c.; nitric acid concentrated, 1 c. c., and hydrochloric acid concentrated, 5 c. c.), and allowed to stand at room temperature overnight. A green or bluish green color is formed. The reaction is very delicate. Indican or blood pigments do not hinder this reaction. A similar method has been described for the quantitative estimation of bile pigment by Hooper and Whipple (1916).

Gmelin's test for bile pigment was used as a routine in the field investigations.

Webster's reaction.—Measure out 12.5 c. c. of the urine in a measuring cylinder, then add 12.5 c. c. of diluted sulphuric acid, made up by mixing 20 c. c. of concentrated sulphuric acid with 80 c. c. of water. Pour the mixture of urine and acid into a separating funnel of 100 to 150 c. c. capacity and provided with a stopcock; add to the mixture 10 c. c. of ether, shake up well, and allow to settle; take out the stopper from the top of the separating funnel, open the stopcock at the bottom and allow the mixture of acid and urine to run off, then turn the stopcock off so as to retain the ethereal solution in the separating funnel. Now add 25 c. c. of tap water to the ethereal solution in the separating funnel and shake up again to remove the traces of the mixture of urine and acid and allow to settle again for two or three minutes, then run off the water by opening the stopcock, retaining the ether in the funnel. Finally, let the ethereal solution flow into an ordinary test-tube and try for the presence of T. N. T. in it as follows:

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Prepare a solution of alcoholic potash by dissolving 4 to 5 grams of caustic potash in 100 c. c. of absolute alcohol. Where many tests are to be carried out this solution may be made by having a stock saturated solution of caustic potash, and adding, when a fresh quantity of the reagent is required, 10 c. c. of this to 90 c. c. of alcohol.

To the ethereal solution obtained as above described 5 c. cm. of this alcoholic solution of potash are added. When T. N. T. is present a purple coloration is at once developed, varying in intensity according to the amount of T. N. T. present, from the faintest trace to a deep purple. The color changes rapidly from the purple to a brown color, and it has been found that the best results as to intensity are obtained by judging rapidly after the color is struck.

6. HISTOLOGICAL EXAMINATION OF TISSUES.

For histological detail, tissues fixed in 10 per cent formalin were cut in paraffin and sections stained with hematoxylin and eosin.

For the demonstration of fat, small pieces of tissues were placed in Marchi's fluid for five to eight days, washed thoroughly in running water, hardened in alcohol, and cut in paraffin.

For staining fatty degenerated myelin-sheaths of nerve fibers, Marchi and Algeri's method was used. Nerves mordanted in Müller's fluid were placed in Marchi's fluid for five to eight days, washed thoroughly in running water, teased, and mounted in glycerin.

For the microchemical demonstration of iron, Perl's reaction was employed. Tissues fixed in formalin and cut in paraffin were subjected for 10 minutes to a mixture of a 2 per cent solution of potassium ferrocyanide, one part, and a 1 per cent solution of hydrochloric acid, three parts, heated to 60° C., after which the sections were differentiated in 0.5 per cent hydrochloric-acid solution and thoroughly washed in distilled water. The sections were then stained with 0.5 per cent aqueous solution of neutral red for three minutes and counterstained with aqueous eosin.

Gelatin-Locke's citrate solution used in the perfusion experiments consisted of equal parts of Locke's solution and 3.8 per cent sodium-citrate solution to which 0.25 per cent gelatin was added. The solution was freshly prepared before each experiment. Rous and Turner (1916) have shown that this solution does not injure the red corpuscles.

7. ACUTE T. N. T. POISONING—THE EFFECT OF THE INHALATION OF OXYGEN GAS ON THE CYANOSIS, INCOORDINATION, AND PULSE RATE.

[100 mg. T. N. T. per kilo, subcutaneously. Killed with chloroform at end of 24 hours.]

Dog 74.—Adult bull mongrel, male, weight 14.5 kilos. Fed a fat raw beef diet for weeks.

March 3, 1919. Dog is in fair condition, slight mange. Hemoglobin 101 per cent.

10.10 a. m. Given subcutaneously 1.45 gms. T. N. T. No. 7 pure, in 48 c. c. cottonseed oil.

10.30 a. m. Given 300 c. c. water by stomach tube.

12.15 p. m. Fed 250 gms. raw fat beef. Shows no cyanosis nor incoordination.

4.15 p. m. Ghastly cyanosis. No incoordination.

March 4. 9 a. m. Animal shows slight incoordination in walking up and down the stairs. Intense cyanosis of tongue and mucous membranes of mouth.

9.45 a. m. Condition unchanged. Pulse 136, respiration 21.

9.48. a. m. Placed in oxygen gas chamber.

9.55. a. m. Pulse 116, respiration 8.

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10.08 a. m. Pulse 112, respiration 12. Excited and struggling. Taken out of gas chamber. Cyanosis is just as marked as before the animal was subjected to oxygen breathing.

10.10 a. m. Pulse 132, respiration 17.

10.15 a. m. Blood contains 112 per cent hemoglobin; is chocolate colored. Spectroscopic examination reveals the presence of considerable methemoglobin. Killed with chloroform.

Autopsy.—Dog is fairly well nourished. No icterus. The injected olive oil has disappeared from the subcutaneous tissues at the site of injection. Subcutaneous and omental fats are normal in color. No increase in serous fluids. Heart and lungs are normal. Stomach normal. Intestines are collapsed, duodenal mucosa is only slightly stained with bile. Mucosa normal. Pancreas and adrenals are normal. Kidneys appear congested. On cut section the cortex is chocolate in color, glomeruli are distinct, and striations are regular. Microscopical sections are normal. Spleen is small and firm. The cut section has a chocolate tinge. Microscopically the pulp shows a few large mononuclear phagocytic cells containing hemosiderin and engulfed red cells. Mesenteric lymph glands are normal. Microscopically the sinuses contain many phagocytes with engulfed red corpuscles. No pigment. Bone marrow of femur is mottled grayish white and dark red. Microscopically, somewhat congested, mostly fat, few phagocytes containing iron-staining pigment and engulfed red cells. Liver is slightly enlarged, pale, and quite fatty in appearance. On cut section the capsule bulges and the lobulation is indistinct. Gall bladder contains 11 c. c. of very dark brown clear bile. Microscopically the liver cells are swollen, very granular, and vacuolated. The liver cells about the efferent veins are loaded with fat droplets of all sizes. The liver cells in the intermediate zones and portal areas contain numerous very small fat droplets (osmic acid). A few of the Kupffer cells contain engulfed red cells and a light brown coarsely granular iron-containing pigment. Sciatic nerve is normal (Marchi method).

[100 mg. T. N. T. per kilo, subcutaneously. Killed with chloroform at end of 25 hours.]

Dog 76.—Adult fox and bull mongrel, male, weight 9.7 kilos. Fat raw beef diet for weeks.

March 3, 1919. Dog is active and in excellent condition. Hemoglobin 114 per cent.

10.15 a. m. Given subcutaneously 970 mg. T. N. T. No. 7 pure in olive oil. 100 mg. T. N. T. per kilo.

10.30 a. m. Given 300 c. c. of water.

12.15 p. m. Given 250 gms. raw fat beef. No cyanosis. No incoordination.

2.30 p. m. Marked cyanosis. No incoordination.

3.24 p. m. Intense cyanosis. Pulse 156, respiration 18.

3.26 p. m. Placed in oxygen gas chamber.

3.31 p. m. Pulse 128.

3.36 p. m. Pulse 108. Taken out of gas chamber. Cyanosis unchanged.

4.15 p. m. Intense cyanosis. Slight incoordination.

March 4.—Intense cyanosis. Slight incoordination on walking up and down the stairs. No icterus. Hemoglobin 94 per cent. Blood is chocolate in color and contains considerable methemoglobin.

11.15 a. m. Killed with chloroform.

Autopsy.—Animal is well nourished. No icterus. Serous cavities are quite normal. Heart and lungs normal. Stomach and intestines normal. Pancreas and adrenals normal in gross and in sections. Kidneys normal. Spleen is slightly enlarged and pulpy. On cut section the parenchyma is chocolate brown in color and scrapes off readily. Microscopically the venules are distended. Splenic pulp contains numerous phagocytes loaded with a coarsely granular iron-containing pigment. Some of the

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pigment granules are almost as large as red cells. Mesenteric lymph glands are normal. Bone marrow of femur mottled grayish white and reddish purple. Microscopically it shows chiefly fat. Several pigmented phagocytes are scattered among the small amount of myeloid tissue present. Liver is swollen and pale. On cut section the capsule bulges, the lobules are somewhat obscured and many isolated yellowish brown opaque areas and purplish red areas are scattered through the parenchyma. Gall bladder is normal and contains 8 c. c. of dark-brown bile. The bile ducts are normal. Microscopically the liver cells are swollen and very granular. Almost all the liver cells contain many fat droplets. However, the cells about the efferent veins contain much more fat than those of the intermediary zones and portal areas (fat stain, osmic acid). There are a few focal accumulations of polyblasts and pigmented endothelial cells. Sciatic nerve is normal.

[100 mg. T. N. T. per kilo, per os. Killed with chloroform at end of 48 hours.]

Dog 75.—Adult brown bull, male, weight 15.5 kilos. Fat raw beef diet for several weeks.

March 3, 1919. Dog in excellent condition. Hemoglobin, 81 per cent.

10.10 a. m. Given, per os, 1.55 gms. T. N. T. No. 5 pure. 100 mg. T. N. T. per kilo.

10.30 a. m. Given 300 c. c. water.

12.15 p. m. Fed 250 gms. raw fat beef. No cyanosis or incoordination

2.30 p. m. Ghastly cyanosis. No incoordination.

2.58 p. m. Condition unchanged. Placed in oxygen-gas chamber.

3.06 p. m. Taken out of gas box. Cyanosis undiminsihed in intensity.

3.08 p. m. Again placed in gas chamber and given increased quantity of oxygen.

3.18 p. m. Taken out of oxygen chamber. Cyanosis unchanged.

March 4. Dog is active. No icterus. Marked cyanosis. Slight incoordination.

March 5. Marked cyanosis. Marked incoordination.

9.48 a. m. Pulse 140. Respiration 20. Placed in oxygen-gas chamber.

9.54 a. m. Pulse 92. Respiration 20.

10.06 a. m. Pulse 92. Respiration 20.

10.10 a. m. Taken out of gas chamber. Cyanosis and incoordination just as marked as before oxygen breathing.

10.15 a. m. Pulse 144. Respiration 20. Hemoglobin, 67 per cent. Blood is chocolate in color and contains methemoglobin.

10.20 a. m. Killed with chloroform.

Autopsy.—No jaundice. No excess of serous fluids. Neck organs normal. Heart and lungs normal. Stomach and intestines normal. Pancreas and adrenals normal. Kidneys are normal in gross and in sections. Spleen is normal in size. On cross section the parenchyma is quite firm and chocolate brown in color. The Malpighian bodies are distinct. Microscopically the venules and pulp engorged with red corpuscles. The pulp contains many phagocytes loaded with a coarsely granular iron-containing pigment. Mesenteric lymph glands are normal. Microscopically the sinuses contain numerous large phagocytes which are loaded with red corpuscles. Bone marrow of femur is mottled grayish white and red. Microscopically there are many macrophages loaded with a light brown pigment and engulfed red blood cells. Liver is swollen and inelastic. On cut section the capsule bulges, the lobulation is obscured, many isolated yellowish-brown opaque areas from 0.5 to 3.0 mm. diameter are scattered through the parenchyma. Gall bladder is normal and contains 12 c. c. dark brown clear bile. Bile ducts are normal. Microscopically the liver cells are swollen and very granular. There is little if any increase in fat (osmic acid). However, many isolated areas of fatty degeneration involving several of the liver lobules are scattered through the parenchyma. Pigmented endothelial cells containing red cells are quite abundant and are definitely continuous with other endothelial cells lining the intralobular capillaries. Sciatic nerve is normal.

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[100 mg. T. N. T. per kilo, subcutaneously. Killed with chloroform at end of 72 hours.]

Dog 77.—Adult bull mongrel, male, weight 11.4 kilos. Raw fat beef diet.

February 4–7, 1919. Given, per os, 62.5 mg. T. N. T. No. 6 crude in gelatin capsules.

March 3. Dog is in excellent condition. Weight 11.0 kilos.

10.15 a. m. Given, subcutaneously, 1.1 gms. T. N. T. No. 7 pure in 37 c. c. olive oil. Hemoglobin, 76 per cent.

10.30 a. m. Given 300 c. c. of water by stomach tube.

12.15 p. m. Fed 250 gms. raw fat beef. No cyanosis or incoordination.

2.30 p. m. Marked cyanosis of tongue and mucous membranes of mouth.

4.15 p. m. Condition unchanged.

March 4. Ghastly cyanosis. Slight incoordination.

March 5. Marked cyanosis. Slight incoordination. No icterus.

March 6. Oral mucous membranes very pale. No cyanosis or icterus. Very marked incoordination. Hemoglobin, 65 per cent. Blood is brownish red in color, clots easily, and contains a little methemoglobin. Body weight, 11.6 kilos.

10.20 a. m. Killed with chloroform.

Autopsy.—Body fat, normal in color. No icterus. No excess of serous fluids. Oesophagus, trachea, and thyroids are normal. Heart and lungs normal in gross. Stomach and intestines normal. Pancreas and adrenals normal. Kidneys are normal in size, capsule strips with difficulty, leaving a roughened cortex. On section the tubules are irregular in some areas; glomeruli are distinct and quite normal in appearance. Microscopically the organ is practically normal. Several obsolete scars are scattered through both kidneys. In these scarred areas several glomeruli and their tubules have been obliterated. The surrounding tubules and glomeruli are normal. Spleen is enlarged; on cross section is pulpy, purplish red, and velvety in appearance. Microscopically the venules and pulp are engorged and contain many nucleated red corpuscles. The pulp contains numerous phagocytes loaded with a coarsely granular iron-containing pigment. Mesenteric lymph glands are normal and contain no pigment. Bone marrow of femur in middle of shaft is fatty. Toward the epiphysis it becomes deep red and uniform. Liver, the capsule is smooth and thin. The cut section shows a conspicuous lobulation. The lobules are enlarged, presenting opaque, yellow-brown centers, and more translucent margins. Several isolated pin point opaque yellowish spots are scattered through the parenchyma. Gall bladder contains 18 c. c. of dark-brown clear bile. The bile ducts are normal. Microscopically the liver cells are swollen and contain fat droplets of all sizes. The fatty cells are most numerous about the efferent veins and diminish in number on approaching the portal areas. A few small areas of focal necrosis are scattered through the parenchyma, involving only a few liver cells and indicated especially by the accumulation of polyblasts. Many of the Kupffer cells contain red cells and coarsely granular hemosiderin. The bile ducts are normal. Sciatic nerve is normal.

[100 mg. T. N. T. per kilo, per os. Killed with chloroform at end of 97 hours.]

Dog 54.—Large adult shepherd, male; weight, 21.90 kilos. Raw fat beef diet.

February 4–7, 1919, given, per os, 2.19 grams T. N. T. No. 4 crude in gelatin capsules.

March 3. Dog active and normal. Weight, 22.5 kilos.

10.10 a. m. Given, per os, 2,250 mg. T. N. T. No. 5, pure, in gelatin capsules. Hemoglobin, 93 per cent.

10.30 a. m. Given 300 c. c. of water.

12.15 p. m. No cyanosis or incoordination. Fed 250 gm. raw fat beef.

4.05 p. m. Pulse 140. Lively. No cyanosis or incoordination. Placed in oxygen gas chamber.

4.10 p. m. Pulse 112. Taken out of gas box.

4.12 p. m. Pulse 144.

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4.30 p. m. Apparently normal.

March 4–6. Dog active and normal. Mucous membranes of mouth and conjunctivae are normal. Raw fat beef diet.

March 7. 9 a. m. Slight incoordination. Weight 22.50 kilos. Mucous membranes of mouth are pale pink. No icterus.

11.20 a. m. Hemoglobin, 87 per cent. Blood is normal in color. No methemoglobin bands. Clot is firm.

11.30 a. m. Killed with chloroform.

Autopsy.—Dog is very well nourished. Serous cavities are normal. Neck organs, œsophagus, trachea, and thyroids are normal. Thorax, heart, and lungs normal. Stomach and intestines normal. Pancreas and adrenals are normal in gross and in sections. Kidneys are normal and contain no fat. Spleen is slightly enlarged and presents a mottled, purplish-red appearance. Microscopically the Malpighian bodies appear normal. The venules and pulp are engorged with red cells. There is a large quantity of coarsely granular light-brown iron-containing pigment in groups of phagocytic cells. The pulp contains several megalocaryocytes. The mesenteric lymph glands in gross appear normal. Microscopically they contain in their sinuses many large phagocytes loaded with red corpuscles and a few which contain both a light-brown granular pigment and red corpuscles. The bone marrow taken from the shaft of the femur is mottled grayish white and reddish brown. Microscopically it is hyperplastic and contains many phagocytes heavily loaded with light-brown iron-containing pigment. Liver is somewhat enlarged, swollen, and fatty. On cut section the lobulations are quite distinct, each having an opaque, yellowish center and a more translucent brownish-red margin. Gall bladder and bile ducts are normal. Microscopically the liver cells are swollen and full of fat vacuoles (fat stain, osmic acid). The fat is chiefly, but not entirely, confined to the central areas (those about the central veins). Most of the cells in the periphery of the lobules retain fairly well their form and staining properties. However, many of these cells contain fat vacuoles. Some of the endothelial Kupffer cells are swollen and contain a moderate amount of coarsely granular iron-containing pigment. Sciatic nerve is normal. The lipoid medullary sheaths are not reduced to fat-like globules.

[100 mg. T. N. T. per kilo, per os on two days. Killed with chloroform 119 hours after administration of first dose.]

Dog 79.—Large adult bull mongrel, male, weight 15.9 kilos. Has been fed a raw fat beef diet several weeks.

March 3, 1919. Animal is in excellent condition and has been gaining in weight.

10.15 a. m. Given, per os, 1.59 gms. T. N. T. No. 5 ure 100 mgs. per kilo. Hemoglobin 86 per cent.

10.30 a. m. Given 300 c. c. of water.

12.15 p. m. Fed 250 gms. raw fat beef. No cyanosis or incoordination.

2.30 p. m. Marked cyanosis. No incoordination.

3.49 p. m. Pulse 160. Placed in oxygen gas chamber.

3.54 p. m. Pulse 116. Taken out of gas chamber. Cyanosis is just as marked.

3.56 p. m. Pulse, 160.

4.15 p. m. Marked cyanosis. No incordination.

March 4. Marked cyanosis. No incoordination. No icterus. Lively.

March 5. Marked cyanosis. No incoordination. No icterus. Lively.

March 6. Animal is active and apparently normal. No cyanosis or incoordination.

4 p. m. Given per os 1.59 gms. T. N. T. No. 5 pure.

March 7. 9 a. m. Marked cyanosis. No incoordination. Vomited during the night. Weight 16.1 kilos.

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9.40 a. m. Hemoglobin 65 per cent. Blood is chocolate in color. Clot is firm. Methemoglobin bands distinctly seen in a 1–140 dilution with distilled water. Marked cyanosis. Pulse 156. Respiration 25.

9.46–56 a. m. 200 c. c. of normal salt containing one per cent ammonium sulphide injected into external jugular vein.

9.56 a. m. Vomits. Pulse 128. Respiration 23. Cyanosis has cleared to great extent. Animal is much more lively. Blood is still chocolate in color. Methemoglobin bands are faintly seen in 1 to 80 dilution with distilled water.

10 a. m. Abundant soft stool.

1.30 p. m. Very little cyanosis. Pulse 148. Respiration 23. Animal is quite lively.

4.30 p. m. Active. Cyanosis is the same as 1.30 p. m.

March 8, 9 a. m. Marked incoordination. No cyanosis. Mucous membranes very pale. No icterus. Weight 16 kilos. Blood is dark red. No methemoglobin bands.

9.30 a. m. Killed with chloroform.

Autopsy.—Subcutaneous, omental, and pericardial fats are abundant and normal in color. No increase in serous fluids. Neck organs, oesophagus, trachea, and thyroids are normal. Heart and lungs are normal. Stomach is normal. Mucosa of small intestine is covered with heavily bile-tinged mucus. Pancreas and adrenals are normal. Kidneys are normal in gross and in sections and contain no fat. Spleen is pulpy and presents a mottled purplish red appearance. Microscopically the venules and pulp are engorged with red corpuscles. A great many nucleated red corpuscles are present. The pulp contains a large number of phagocytes loaded with coarsely granulated hemosiderin. Many of the granules are as large as red cells. The mesenteric lymph glands are normal. Microscopically they contain in their sinuses many nucleated red corpuscles and phagocytes loaded with red corpuscles. The bone marrow taken from the shaft of the femur is normal in gross. Liver is slightly enlarged, pale and fatty looking. On section the center of all lobules are opaque and yellowish brown in color, the peripheries are translucent reddish brown. The gall bladder is normal and contains 20 c. c. very dark brown bile. The bile ducts are normal. Microscopically the liver cells are swollen and those especially about the central veins are full of fat vacuoles (fat stain, osmic acid). The fat-containing liver cells extend through the mid-zonal area of the lobules and in some instances liver cells loaded with fat droplets are seen in the portal areas. Most of the Kupffer cells contain hemosiderin and engulfed red cells. The bile ducts are unchanged. Sciatic nerve is normal. Osmic acid (Marchi) faintly tinges the myeline sheaths. There is no accumulation of fat-like globules.

8. CHRONIC T. N. T. POISONING IN DOGS.

Dog 1.—Old St. Bernard, male. Body weight, 30 kilos. Raw beef diet. 16.5 mg. T. N. T. (No. 1 crude) per kilo, per os. 14 gm. T. N. T. administered during 56 days. Incoordination and intermittent cyanosis. Conjunctivae definitely jaundiced from 51st day until death on the 57th day with considerable bile pigment in the urine. On the day of death the blood contained 30 per cent red corpuscles. There were 137 reticulated red corpuscles per thousand red corpuscles. Body weight, 20.9 kilos.

Necropsy.—Moderate emaciation. Definite icterus. Acute splenic tumor. Spleen pulp heavily sprinkled with phagocytes loaded with coarsely granular hemosiderin. Malpighian bodies show small areas of coagulation necrosis. Acute suppurative nephritis with multiple kidney abscesses. Liver shows increased pigmentation. Bile is very dark and stringy. Microscopically the liver cells about the efferent veins contain fat droplets. The marginal cells are swollen and granular. Kupffer cells are filled with coarsely granular hemosiderin. No scarring. Bone marrow not examined.

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Dog. 2.—Adult bull mongrel, female. Body weight, 15.2 kilos. Raw beef diet. 33 mg. T. N. T. (No. 4 crude) per kilo, per os. 37 gm. T. N. T. administered during 114 days. Cyanosis and incoordination especially at the beginning of the experiment. Food consumption satisfactory until the 48th day when the animal began to lose weight. Urine contained a trace of bile pigments intermittently until the 109th day when the conjunctivae became definitely jaundiced and the urine contained considerable bile pigments until death on the 115th day. On the 114th day the blood contained 41 per cent hemoglobin; 3,384,000 red corpuscles; 44,400 white corpuscles; 120 reticulated red corpuscles per thousand red corpuscles and 26 erythroblasts were seen in counting 200 white corpuscles. The differential count showed 90.5 per cent polymorphonuclear, 7 per cent mononuclear, and 2.5 per cent transitionals. The total blood volume was 497 cc. which represented 65 cc. blood per kilo, body weight. Body weight, 7.7 kilos.

Necropsy.—Extreme emaciation. Definite icterus. Lungs show several small areas of bronchopneumonia. Spleen is small and firm. Cut surface is of a reddish brown color. Pulp is heavily sprinkled with phagocytes holding a coarsely granular iron-containing pigment. Kidneys are normal. Liver is slightly enlarged. The capsule is smooth. On cut section the lobules are distinctly outlined with opaque yellowish brown centers and more translucent reddish brown peripheries. Gall bladder contains 11 cc. of very dark viscid bile. Microscopically the liver cells surrounding the efferent veins are filled with fat droplets. The marginal cells are normal. No scarring. Many of the Kupffer cells are swollen and contain coarsely granular hemosiderin. Bone marrow of femur is intensely hyperplastic and contains numerous hemosiderin-holding phagocytes. Sciatic nerve shows an extensive degeneration of the myeline sheaths similar to that induced after a deficient diet over a long period.

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TABLE 1.

5mg. T. N. T. (No. 4 crude) per kilo, subcutaneously. Total amount of T. N. T. given=7.97 grams.

DOG 29.

[Mixed diet 9 days before beginning experiment.]

Day of experiment.	Food eaten daily (gms.).	T. N. T. given.	Body weight.	Temperature (rectal).	Clinical symptoms.		Urine.			Feces.	Remarks.
					Character of mucous membranes.	Incoordination.	Color.	Bile pigment.	Webster's reaction.		
		Mg.	*Kilos.*	*°C.*							
1-2	.....	59.5	11.9	.....	Normal.....	None...	.....	None....	Negative	.....	Young adult bull mongrel, bitch. T. N. T. administered in 1.98 c. c. olive oil.
3-4	.....	59.5	11.1	.....	Slight cyanosis	Present.	.....	...do....	...do....	.....	
6-11	200 bread, 200 milk, 100 meat.	59.5	11.3	38.3	Normal.....	Slight...	.....	+Slight.	+Slight.	Diarrhea..	Slight salivation.
13-18	.....do.....	59.5	11.6	38.3	.....do.....	...do....	.....	None....	Negative	...do.....	Salivation.
20-25	250 bread, 250 milk, 100 meat.	59.5	11.2	38.3	.....do.....	...do....	.....	...do....	...do....	...do.....	Slight salivation. In excellent condition.
27-32	.....do.....	59.5	11.3	.....	.....do.....	None....	.....	...do....	...do....	...do.....	Slight salivation.
34-39	.....do.....	59.5	11.5	.....	Slight cyanosis	...do....	.....	...do....	.....	...do.....	Lively.
41-46	275 bread, 275 milk, 50 meat.	59.5	11.6	.....	Slight icterus?.	...do....	.....	...do....	.....	...do.....	
48-53	225 bread, 225 milk, 50 meat.	59.5	11.5	.....	Pale.....	...do....	.....	...do....	.....	...do.....	Upper eyelids swollen.
55-60	200 bread, 200 milk, 50 meat.	59.5	11.5	.....	Very pale.....	...do....	Brown.....	...do....	Negative	Soft.....	Salivation.
62-67	225 bread, 225 milk, 50 meat.	59.5	11.9	.....	.....do.....	...do....	Light brown..	...do....	...do....	...do.....	
69-74	.....do.....	59.5	11.9	.....	Slight cyanosis, pale pink.	...do....	Brown.....	+Slight.	...do....	...do.....	Slight salivation. Lively. Well nourished.
76-81	.....do.....	59.5	11.7	.....	Pale pink.....	...do....	.....do.....	++.....	...do....	...do.....	
83-88	250 bread, 250 milk, 50 meat.	59.5	11.9	.....	.....do.....	...do....	.....do.....	+.....	...do....	...do.....	
90-95	225 bread, 225 milk, 50 meat.	59.5	11.5	.....	.....do.....	...do....	.....do.....	+.....	.....	...do.....	Very active. Well nourished.
97-102	250 bread, 250 milk, 50 meat.	59.5	11.3	.....	.....do.....	...do....	Dark brown...	++.....	.....	Diarrhea..	In excellent condition.

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TABLE 1—Continued.

DOG 29—Continued.

Day of experiment.	Food eaten daily (gms.).	T. N. T. given.	Body weight.	Temperature (rectal).	Clinical symptoms.		Urine.			Feces.	Remarks.
					Character of mucous membranes.	Incoordination.	Color.	Bile pigment.	Webster's reaction.		
		Mg.	*Kilos.*	*° C.*							
104–109	250 bread, 250 milk, 50 meat.	59.5	11.4	.....	Pale pink.....	None ...	Brown.....	None....	.....	Soft.....	
111–116	275 bread, 275 milk, 50 meat.	59.5	11.5	.....	.....do.....	...do....	Light brown..	+.....	.....	Diarrhea..	
119–123	.....do.....	59.5	10.6	.....	Mucous membranes and tongue pink.	.....	.....do.....	+Slight.	.....	Soft.....	Still in fair nutritional state. Slightly thinner. Beginning mange.
125–130	250 bread, 250 milk, 50 meat.	59.5	10.9	.....	.....	.....	Brown.....	...do....	.....	Diarrhea..	
132–137	275 bread, 275 milk, 50 meat.	59.5	10.2	.....	.....	.....	.....do.....	...do....	.....	...do.....	
139–144	250 bread, 250 milk, 50 meat.	59.5	9.7	.....	.....	.....	Light brown..	...do....	.....	Soft.....	
146–151	275 bread, 275 milk, 50 meat.	59.5	9.9	.....	Pale pink.....	.....	.....do.....	None....	.....	...do.....	Poorly nourished. Extensive mange.
153–158	.....do.....	59.5	10.1	.....	.....	.....	.....	.....	.....	...do.....	
159	None.....	.....	8.6	.....	.....	.....	.....	.....	.....	.....	6 p. m. found dead.

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Day of experiment.	Hb.	Red cells per c. mm.	Reticulated reds.	White cells per c. mm.	Differential count.						Nucleated reds.	Character of reds.	Blood volume.		Plasma.				Clot.
					Small monos.	Large monos.	Pmn. n.	Pmn. eos.	Pmn. bas.	Tr.			Plasma.	Total.	Character.	Per cent.	Hemolysis.	Webster's reaction.	
	Per ct.				*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*			*c. c.*	*c. c.*					
1	104	7,404,000	1	18,600	12	7	79	.....	.....	2	0	Normal.....	541	1,176	Water, clear.....	46	None.	Negative.	Firm.
6	95	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
11	54	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
14	56	3,576,000	91	20,200	16	5	78	.....	.....	1	83	Anisocytosis, basophilia, polychromatophilia.	589	866	Amber, clear....	68	None.	Negative.	Do.
21	68	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
25	67	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
28	81	5,880,000	9	11,200	12	.5	86	1	.....	.5	3	Anisocytosis....	555	925	Light brown, clear.	60	None.	+Slight..	Do.
32	79	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
35	85	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
39	68	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
44	75	7,560,000	8	9,000	12	1	84	.....	.....	3	1	Anisocytosis....	557	898	Amber, yellow..	62	None.	Negative.	Do.
47	63	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
51	57	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
58	62	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
70	95	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
75	96	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
78	96	6,672,000	.....	10,400	2.5	3.5	90.5	.....	0.5	3	8	Anisocytosis....	549	1,144	Amber, clear....	48	None.	Negative.	Do.
86	87	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
93	78	4,320,000	.....	16,400	8	1	86	.....	.....	5	36	Anisocytosis....	544	971	Amber, clear....	56	None.	Negative.	Do.
99	64	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
103	69	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
107	58	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
112	67	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
115	67	4,760,000	.....	11,600	5	1	92	.....	.....	2	7	Anisocytosis, poikilocytosis.	779	1,277	Amber.....	61	.....	.....	.....
130	68	4,544,000	.....	20,000	2	5	93	.....	.....	.....	2	Anisocytosis....	.....	.....	Clear.....	63	.....	.....	.....
140	62	4,568,000	.....	14,400	7	.....	93	.....	.....	.....	0	Normal.....	722	1,076	.....do.....	67	.....	.....	Do.
150	52	3,344,000	.....	20,600	9.5	1.5	88	.....	.....	1	1	Slight anisocytosis.	.....	.....	Pale amber, clear	72	.....	.....	Do.

September 21, 1918.—Autopsy.—Dog is poorly nourished. Extensive mange. Oral mucous membrane shows a few superficial ulcerations. Conjunctivæ are intact. No icterus. Serous cavities normal. Heart and lungs normal. Kidneys are normal in gross and in sections. Spleen is normal in size. The cut section shows a definite increased pigmentation. Microscopically the pulp is heavily sprinkled with mononuclear phagocytes loaded with hemosiderin. The Malpighian bodies appear normal. Bone marrow of femur deep brownish red and granular. Microscopically it is hyperplastic and contains many phagocytes loaded with coarsely granular hemosiderin. Liver is swollen and pale. Gall bladder and bile ducts are normal. Microscopically the liver cells are swollen and granular. The periportal connective tissue is not increased. The capillaries contain many endothelial cells loaded with coarsely granular hemosiderin.

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TABLE 2.

[5 mg. T. N. T. (No. 7 pure) per kilo, subcutaneously. Total amount T. N. T. given=8.33 grams.

DOG 13.

[Mixed diet 8 days before beginning experiment.]

Day of experiment.	Food eaten daily (grams).	T. N. T. given.	Body weight.	Clinical symptoms.		Urine.			Feces.	Remarks.
				Character of mucous membranes.	Incoordination.	Color.	Bile pigment.	Webster's reaction.		
		Mg.	*Kilos.*							
1	250 bread, 250 milk, 100 meat	46.5	9.3	Normal	None		None	Negative		Adult bull, bitch. T. N. T. administered in 1.53 c. c. refined corn oil, mazola.
2–4	do	46.5	9	Slight cyanosis	do		do	+ Slight	Soft	
6–11	125 bread, 125 milk, 50 meat	46.5	8.8	do	do		do	do	do	Slight salivation.
13–18	75 bread, 75 milk, 75 meat	46.5	8.6	do	do		do	do	do	
20–25	75 bread, 75 milk, 50 meat	46.5	8.2	do	Slight		do	Negative	do	
27–32	200 bread, 200 milk, 50 meat	46.5	8.2	Normal	None		do	do	do	
34–39	250 bread, 250 milk, 50 meat	46.5	8	do	do		do		do	Slight salivation. Lively.
41–46	200 bread, 200 milk, 50 meat	46.5	8	Slight cyanosis	Slight		do		do	Slight salivation.
48–53	do	46.5	7.6	Pale pink	None		do		do	Slight salivation. Lively.
55–60	225 bread, 225 milk, 50 meat	46.5	7.4	do	do	Yellow	do	Negative	do	Lively. Extensive mange.
62–67	do	46.5	7.3	do	do	Light brown	do	do	do	
69–74	do	46.5	7.3	do	do	do	+ Slight	do	do	Still well nourished. Lively.
76–81	do	46.5	7.4	do	do	do	do	do	do	Extensive mange.
83–88	do	46.5	7.2	do	do	do	None	do	do	Do.
90–95	do	46.5	7.1	do	Slight	do	do		do	
97–102	250 bread, 250 milk, 50 meat	46.5	6.7	do	do	do	+		Diarrhea	
104–109	225 bread, 225 milk, 50 meat	46.5	7.1	do	do	do	+ Slight		Soft	
111–116	do	46.5	7.2			do	do		do	
118–123	250 bread, 250 milk, 50 meat	46.5	6.7	Very pale		do	None		do	Rather thin. Extensive mange.
125–130	do	46.5	6.7			do	+ Slight		do	
132–135	do	46.5	6.5			Yellow	+		do	
137–137	225 bread, 225 milk, 50 meat	46.5	6.4			Bloody	None		do	
[illegible]	do	46.5	6.3			Light brown	do		do	
[illegible]	do	46.5	5.9			do	do		do	
[illegible]	250 bread, 250 milk, 50 meat	46.5	6.4	Pale pink	Slight	do	do		do	Fairly good condition. Extensive mange.
[illegible]	do	46.5	6.3	do	do		do		do	
[illegible]	do	46.5	6.4	do	None				do	
[illegible]	do	46.5	6.3	do	do				do	
[illegible]	250 bread, 250 milk, 50 meat	46.5	6.3	do	do				do	

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170–172	.....do.....	46.5	6	.....do.....	...do.....	Straw.....	None.....		Hard.....	
174–179	225 bread, 225 milk, 50 meat...	46.5	6.7	.....do.....	...do.....	Light straw...	...do.....		...do.....	
181–186	250 bread, 250 milk, 50 meat...	46.5	7.4	.....do.....	...do.....	Straw.....	...do.....		...do.....	
188–193	.....do.....	46.5	7.5	.....do.....	...do.....	.....do.....	...do.....		...do.....	
195–200	.....do.....	46.5	7.6	.....do.....	...do.....	Yellow.....	...do.....		Soft.....	
202–207	.....do.....	46.5	7.5	.....do.....	...do				...do.....	
209–214	.....do.....		7.6	.....do.....	...do.....				...do.....	
216–221	.....do.....		7.4	.....do.....	...do.....				...do.....	
223–224	.....do.....		8.2	Normal.....	...do.....					Extensive mange. Otherwise in good condition.
225										10.10 a. m. killed with chloroform.

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TABLE 2—Continued.

DOG 13—Continued.

Day of experiment.	Hb.	Red cells per c. mm.	Reticulated reds.	White cells per c. mm.	Differential count.						Nucleated reds.	Character of reds.	Blood volume.		Plasma.				Clot.
					Small monos.	Large monos.	Pmn. n.	Pmn. eos.	Pmn. bas.	Tr.			Plasma.	Total.	Character.	Per cent.	Hemolysis.	Webster's reaction.	
	Per ct.				Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.			c. c.	c. c.					
1	86	6,000,000	2	14,600	14	2	64	17	.....	3	0	Normal.....	432	785	Water, clear.....	55	None.	Negative.	Firm.
6	70	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
11	68	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
16	54	4,856,000	56	13,000	20	3	69	5	.....	3	58	Anisocytosis, basophilia.	430	632	Amber, clear....	68	None.	+	Firm.
20	52	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
25	58	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
29	63	5,416,000	66	20,000	17	1	78	3	.....	1	25	Marked anisocytosis, basophilia.	426	676	Amber, clear....	63	None.	+Slight..	Firm.
35	52	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
39	52	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
45	53	3,712,000	112	15,600	19	4	73	3	.....	1	96	Anisocytosis, basophilia.	471	654	Amber, yellow..	72	None.	Negative.	Firm.
47	46	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
51	53	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
58	69	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
70	64	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
75	58	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
78	59	4,864,000	.....	17,600	8.5	2.5	86.5	.....	.....	2.5	2	Slight anisocytosis.	455	722	Amber, clear....	63	None.	Negative.	Firm.
86	56	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
92	50	3,456,000	.....	18,200	5	2.5	89.5	.....	.....	3	2	Normal.....	484	701	Amber, clear....	69	None.	Negative.	Firm.
93	47	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
99	50	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
103	50	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
107	52	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
112	59	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
115	56	4,744,000	.....	9,800	9	.5	89.5	.....	.....	2	1	Slight anisocytosis	546	760	Clear.....	72	.....	.....	.....
131	56	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
141	60	5,552,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
151	76	5,128,000	.....	12,400	7.5	.....	90.5	.....	.....	2	1	Anisocytosis.....	.....	.....	Lipaemia.....	64	.....	.....	.....
161	67	5,168,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
164	69	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	457	775	Amber, clear....	72	.....	.....	.....
182	69	5,528,000	.....	13,000	11.5	.5	87	.....	.....	1	0	Anisocytosis.....	395	658	Amber, clear....	60	.....	.....	.....
212	85	5,576,000	.....	11,400	16	2	80	.....	1	1	0	Anisocytosis.....	.....	.....	Pale amber, clear	54	.....	.....	.....
224	101	6,704,000	.....	11,600	16	3	80.5	.5	.....	.....	0	Normal.....	497	1,014	Lipaemia ++...	49	.....	.....	.....

February 25, 1919.—Autopsy.—Dog is fairly well nourished. Extensive mange. Oral mucous membrane and conjunctivae are normal. Subcutaneous fat fairly abundantnda normal in color. The subcutaneous tissues at site of T. N. T. injections are somewhat indurated and dyed yellow. No excess of serous fluids. Heart and lungs normal. Stomach and intestines normal. Pancreas, adrenals and kidneys are normal in gross and in sections. Spleen is very small. On section the parenchyma is scanty though normal in color. The connective tissue stroma is abundant. Microscopically the Malpighian bodies are well defined and normal. The pulp contains very few red cells and there are no pigmented phagocytes. The reticular cells with elongated nuclei are very abundant. Mesenteric lymph glands are normal. Bone marrow is mottled gray and pink. Liver is normal in gross and microscopically. Gall bladder contains 6 c. c. light brown normal looking bile. Bile ducts are normal.

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TABLE 3.

[5 mg. T. N. T. (No. 6 crude) per kilo, per os. Total amount T. N. T. given, 13.7 grams.]

DOG 23.

[Mixed diet 8 days before beginning experiment.]

Day of experiment.	Food eaten daily (grams).	T.N.T. given.	Body weight.	Clinical symptoms.		Urine.			Feces.	Remarks.
				Character of mucous membranes.	Incoordination.	Color.	Bile pigment.	Webster's reaction.		
		Mg.	*Kilos.*							
1–2	160 bread, 160 milk, 66 meat	75.5	15	Normal	None					Adult hound, mongrel, male. Excellent condition.
3–9	do	75.5	14.4	do	Present		+Slight.	Negative	Soft	Slight salivation; 9th day vomited.
10–16	do	75.5	14.1	Slight cyanosis	Slight		do	do	Diarrhea	
18–24	250 bread, 250 milk, 100 meat	75	13.9	Pale	do		+	do	do	Slight salivation.
26–30	200 bread, 300 milk, 75 meat	75	13.7	Icterus?	do		+Slight.	do	do	Droopy.
32–37	200 bread, 200 milk, 50 meat	75	13.7	Slight icterus?	do		do	do	do	
39–44	250 bread, 250 milk, 55 meat	75	13.5	Pale pink	Present		do		do	Lively.
46–51	225 bread, 225 milk, 50 meat	75	13.3	Very pale	Marked		do		do	Conjunctivitis.
53–58	do	75	12.8	do	do	Light brown	+	Negative	Soft	Do.
60–65	250 bread, 250 milk, 50 meat	75	12.7	do	do	do	+	do	do	Do.
67–72	275 bread, 275 milk, 50 meat	75	12.3	do	do	do	+	do	do	Droopy; rather thin; mange.
74–79	225 bread, 225 milk, 50 meat	75	11.6	do	Slight	do	+	do	do	Conjunctivitis; extensive mange.
81–86	do	75	11.4	do	do	do	+	do	do	Salivation.
88–93	do	75	11	do	do	do	++		do	Very extensive mange.
95–100	do	75	10.8	do	do	do	+Slight.		Diarrhea	Slight conjunctivitis.
102–107	235 bread, 235 milk, 50 meat	75	11	do	do	do	+		Soft	
109–114	250 bread, 250 milk, 50 meat	75	11.3	do	do	do	+		do	
116–121	do	75	10	do	do	do	+		do	Emaciated. Marked decline in last 2 weeks. Conjunctivitis, mange.
123–128	225 bread, 225 milk, 50 meat	75	10.2	do	do	do	+		Diarrhea	Extensive mange. Weak, staggers after walking a short time. Severe conjunctivitis of left eye.
129–132	250 bread, 250 milk, 50 meat	75	10.2			Yellow	+Slight.		Soft	
134–135	225 bread, 225 milk, 50 meat	75	10.1			Yellow, cloudy	None		do	
137–139	250 bread, 250 milk, 50 meat	75	10.2			Light brown	+Slight.		do	
141–142	265 bread, 265 milk, 50 meat	75	9.6			do	None		do	
144–149	225 bread, 225 milk, 50 meat	75	10.1	Pink	Slight	do	do		do	Emaciated; mange on hind leg. Conjunctivitis of left eye.
151–156	do	75	9.8			do	+		do	
158–159	265 bread, 265 milk, 50 meat	75	9.9			do	+		do	
161–164	250 bread, 250 milk, 50 meat	75	9.9						do	
165–166	300 bread, 300 milk, 50 meat	75	10						do	
168–170	250 bread, 250 milk, 50 meat	75	10			Light brown	+		do	

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TABLE 3—Continued.

DOG 23—Continued.

Day of experiment.	Food eaten daily (grams).	T.N.T. given.	Body weight.	Clinical symptoms.		Urine.			Feces.	Remarks.
				Character of mucous membranes.	Incoordination.	Color.	Bile pigment.	Webster's reaction.		
172–177	225 bread, 225 milk, 50 meat	*Mg.* 75	*Kilos.* 10.1			Light brown	+		Soft	
179–184	300 bread, 300 milk, 50 meat	75	10			Straw	+Slight.		do	
186–191	do	75	10.1			do	do		do	
193–198	do	75	9.9			Yellow	+		do	
200–205	do	75	9.9						do	
207–208	250 bread, 250 milk, 50 meat	75	10			Yellow	+Slight.		do	Extensive mange.
209	do	75				do	None		do	Given 100 c. c. 20 per cent (by volume) alcohol.
210	do	75				Light yellow	do		do	Given 150 c. c. 20 per cent (by volume) alcohol.
211	do	75				Yellow	do		do	Given 150 c. c. 30 per cent (by volume) alcohol.
212	350 bread, 350 milk, 50 meat	75				do	do		do	Given 200 c. c. 30 per cent (by volume) alcohol.
214	None		11.0			Straw, cloudy	do		do	Given 200 c. c. 40 per cent (by volume) alcohol. Marked intoxication. 8 a. m. found dead.

Day of experiment.	Hb.	Red cells per c. mm.	Reticulated reds.	White cells per c. mm.	Differential count.						Nucleated reds.	Character of reds.	Blood volume.		Plasma.				Clot.
					Small monos.	Large monos.	Pmn. n.	Pmn. eos.	Pmn. bas.	Tr.			Plasma.	Total.	Character.	Per cent.	Hemolysis.	Webster's reaction.	
	Per ct.				*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*			*c. c.*	*c. c.*					
1	94	7,168,000	1	11,300	13	3	72	9		3	0	Normal	719	1,409	Water, clear	51	None.	Negative.	Firm.
4	89																		
9	69																		
14	65	5,000,000	4	12,200	7	1	83	7		2	27	Normal	690	1,062	Amber, clear	65	None.	Negative.	Do.
19	61																		
23	57																		
27	55	4,768,000	30	11,200	4	3	91	1		1	4	Slight anisocytosis, basophilia.	751	1,104	Amber, clear	68	None.	+Slight.	Do.

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30	50																		
33	51																		
37	54																		
43	53	4,296,000	1	5,800	4	2	84	9		1	3	Anisocytosis	788	1,126	Amber, clear	70	None.	Negative.	Do.
45	44																		
49	43																		
56	57																		
68	60																		
73	57																		
76	51	3,456,000		12,000	5	2.5	87			5.5	0	Anisocytosis	728	1,040	Amber, clear	70	None.	Negative.	Do.
84	52																		
86	54	3,112,000		14,800	8		88	1		3	1	Anisocytosis, slight poikilocytosis.	730	1,074	Water, clear	68	None.	Negative.	Do.
91	53	2,992,000		9,400	9	3	85			3	2	Slight anisocytosis.	747	1,069	Amber, clear	70	None.	...do....	Do.
97	47																		
101	52																		
105	49																		
110	56																		
115	49	2,968,000		11,800	6.5	2	86		2.5	3	4	Slight anisocytosis.			Clear	75			
118	49	3,104,000		13,600	9.5	12.5	78				3	Anisocytosis	785	1,059	.....do	74			Do.
122	49	3,624,000														74			Do.
126	57	4,848,000		10,000		9	86.5	3		1.5	1	Normal	850	1,180	Clear	72			Do.
129	56																		
139	58	3,712,000		10,200	5.5		94			.5	0	Normal	725	1,082	Clear	67			Do.
149	60	3,416,000		14,600	10		85		1	3	0	Slight anisocytosis.			Water, clear				Do.
159	51	3,280,000		10,800									727	1,069	Pale amber, clear	68			
162	55																		Do.
180	55	3,832,000		13,600	9		90.5			.5	0	Anisocytosis	721	1,030	Water, clear	70			Do.
207	66	3,360,000		12,400	2	6	90	2			0	.....do	749	1,152	Amber, clear	65			Do.
210	65																		Do.

February 17, 1919—Autopsy.—Dog is poorly nourished. Very extensive mange. Oral mucous membrane and conjunctivae are intact. No icterus. Heart dilated. Lungs normal. Stomach and intestines normal. Pancreas and adrenals normal. Kidneys are scarred and somewhat contracted. The capsule strips with difficulty. The cortex is narrow, the striae are irregular. The glomeruli are conspicuous, many appearing as dull opaque pin point dots. Microscopically the kidney shows a mild chronic diffuse nephritis. Spleen is swollen. The cut section is deep red. The pulp scrapes with ease. Malpighian bodies are not conspicuous. Microscopically the venules and pulp are engorged with red corpuscles. There are no pigmented phagocytes. The Malpighian bodies are well defined. Mesenteric lymph glands are normal. Bone marrow of femur is mottled gray and red. Microscopically the marrow is hyperplastic. Liver is enlarged and swollen. The capsule is thin. On cut section the lobules are indistinct. Gall bladder and bile ducts are normal. Microscopically the liver cells are swollen and very granular. No scarring and no pigmented endothelial cells.

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TABLE 4.

5 mg. T. N. T. (No. 7 pure) per kilo, per os. Total amount T. N. T. given—3.68 grams.]

DOG 24.

[Mixed diet 9 days before beginning experiment.]

Day of experiment.	Food eaten daily (gms.).	T. N. T. given.	Body weight.	Clinical symptoms.		Urine.		Feces.	Remarks.
				Character of mucous membranes.	Incoordination.	Bile pigment.	Webster's reaction.		
		Mg.	*Kilos.*						
1–2	250 bread, 250 milk, 100 meat	111.5	22	Normal	None	None			Old hound mongrel, male. Good condition.
4–9	225 bread, 225 milk, 80 meat	111.5	21.1	do	Present	do	Negative	Soft	Slight salivation.
11–16	No bread, no milk, 100 meat	111.5	20.4	do	do	+Slight.	do	Diarrhea	
18–23	35 bread, 35 milk, 15 meat	111.5	18.7	Slight cyanosis; slight icterus?.	Marked	+	do	do	
25–30	30 bread, 30 milk, 20 meat	111.5	17.4	Slight icterus?	Present	+	do	Soft	Extremely weak.
32–37	16 bread, 16 milk, 4 meat	111.5	15.5	do	do	None	do	Diarrhea	Is barely able to stand. Sick.
40	None	111.5	14.3	Very pale	do	do			1 p. m. very sick. Conjunctivitis. 6 p. m. died.

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Day of experiment.	Hb.	Red cells per c. mm.	Reticulated reds.	White cells per c. mm.	Differential count.					Nucleated reds.	Character of reds.	Blood volume.		Plasma.				Clot.
					Small monos.	Large monos.	Pmn. n.	Pmn. eos.	Tr.			Plasma.	Total.	Character.	Per cent.	Hemolysis.	Webster's reaction.	
	P. ct.				*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*		*c. c.*	*c. c.*					
1	97	8,560,000	3	18,000	11	2	81	4	2	0	Normal.....	1,002	2,004	Slight lipaemia....	50	None.	Negative.	Firm.
4	91	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
9	71	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
14	71	5,920,000	9	11,200	11	2	79	7	1	5	Slight basophilia.....	1,031	1,748	Amber, clear.....	59	...do..	+Slight..	Firm.
18	71	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
22	54	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
26	58	5,232,000	162	24,200	4	3	92	.....	1	32	Anisocytosis.basophilia	890	1,348	Light brown, clear	66	...do..	+Slight..	Firm.
28	54	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
32	64	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
36	63	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
39	55	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

August 26, 1918.—Autopsy.—Dog is poorly nourished. Oral mucous membrane and conjunctivæ are intact. Pericardial and omental fats are normal in color. No icterus Heart and lungs are normal. Intima of aorta is normal in color. Pancreas is normal. Adrenals are hemorrhagic. Kidneys are somewhat contracted. The capsule strips with difficulty leaving a scarred and cystic cortex. On cut section the cortex is narrowed, the striæ are irregular and the glomeruli appear as translucent and opaque pin point dots. Microscopically the kidneys show a mild chronic diffuse nephritis. Spleen appears atrophic and shows some increased pigmentation. Microscopically the Malpighian bodies appear normal. There is a definite concentration of the trabeculæ. The venules as well as the pulp contain many nucleated red cells. There are many large mononuclear cells filled with hemosiderin. Mesenteric lymph glands show some increased pigmentation. Microscopically the sinuses are filled with coagulated fluid containing a few ragged wandering cells. Many large reticular cells are filled with hemosiderin in lymph cords. Bone marrow is mottled gray and brownish red and extends high into the shaft of the femur. Microscopically the marrow is definitely hyperplastic, contains numerous nucleated red cells and many phagocytes loaded with hemosiderin. Liver is anemic. Gall bladder and bile ducts are normal. Microscopically the liver shows no scarring. There are a few foci of liver cell necrosis. A few of the endothelial cells are filled with coarsely granular hemosiderin. Sciatic nerve (Marchi) shows a definite but not extensive myeline degeneration.

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TABLE 5.

[20 mg. T. N. T. (No. 7 pure) per kilo, subcutaneously. Total amount T. N. T. given=22.042 grams.]

DOG 27.

[Mixed diet 9 days before beginning experiment.]

Day of experiment.	Food eaten daily (gms.).	T. N. T. given.	Body weight.	Temperature (rectal).	Clinical symptoms.		Urine.			Feces.	Remarks.
					Character of mucous membranes.	Incoordination.	Color.	Bile pigment.	Webster's reaction.		
		Mg.	*Kilos.*	° *C.*							
1	None	206	10.3		Normal	None		None	Negative		Young adult bull terrier, male. T. N. T. administered in 6.9 c. c. refined corn oil, mazola.
2–4	125 bread, 125 milk, 50 meat.	206	10		do	Marked		++	do	Soft	Slight salivation.
6–11	250 bread, 250 milk, 100 meat.	206	9.9	38.5	Slight cyanosis	Present		None	+	do	Do.
13–18	do	206	10.3	38.3	Normal	Slight		do	Negative	do	Do.
20–25	do	206	10.4	38.2	Slight cyanosis	do		do	+	do	Do.
27–32	250 bread, 300 milk, 75 meat.	206	10.4		Normal	None		do	+ Slight	do	Slight salivation. Fairly well nourished.
34–39	250 bread, 250 milk, 50 meat.	206	10.7		Slight cyanosis, very pale.	Slight		do		Diarrhea	Slight salivation.
41–46	do	206	11.1		do	do		do		do	Slight salivation. Lively.
48–53	260 bread, 260 milk, 50 meat.	206	11		do	None		do		do	Slight salivation.
55–60	250 bread, 250 milk, 50 meat.	206	11.2		do	do	Dark brown	+	Negative	do	Well nourished.
62–67	do	206	11.1		do	do	Light brown	+ Slight	do	do	
69–74	240 bread, 240 milk, 50 meat.	206	11.5		do	Slight	Brown	+	do	do	Lively. Well nourished.
76–81	260 bread, 260 milk, 50 meat.	206	11.5		Very pale	do	do	+	do	do	Salivation.
83–88	225 bread, 225 milk, 50 meat.	206	11.4		do	do	Light brown	+	do	do	Marked salivation.
90–95	200 bread, 200 milk, 50 meat.	206	10.8		do	do	Dark brown	+		do	
97–102	275 bread, 275 milk, 50 meat.	206	10.4		do	do	do	++		do	Salivation.
104–109	250 bread, 250 milk, 50 meat.	206	10.8		do	do	Light brown	+		do	

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111–116	.....do.....	206	11.2	.....	.....do.....	.....do.....	.....do.....	+ Slight.....	.....	...do.....	In weak condition, staggers after walking a short distance. Profuse salivation.
119–123	200 bread, 200 milk, 50 meat.	206	9.6	.....	Extremely pale, ulcerated.	Due to weakness.	.....do.....	+	.....	...do.....	
125–126	None.....	206	.....	.....	.....do.....	.....	.....do.....	None.....	.....	Soft.....	Condition unchanged.
130	.....do.....	.....	8.2	.....	.....	.....	Post-mortem dark brown.	Post-mortem ++.	.....	.....	8 a. m. found dead.

Day of experiment.	Hb.	Red cells per c. mm.	Reticulated reds.	White cells per c. mm.	Differential count.						Nucleated reds.	Character of reds.	Blood volume.		Plasma.				Clot.
					Small monos.	Large monos.	Pmn. n.	Pmn. eos.	Pmn. bas.	Tr.			Plasma.	Total.	Character.	Per cent.	Hemolysis.	Webster's reaction.	
	Per ct.				Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.			c. c.	c. c.					
1	94	7,952,000	1	21,000	28	5	60	4	.....	3	0	Normal.....	515	954	Water, clear.....	54	None.	Negative.	Firm.
6	77	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
11	70	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
14	76	5,632,000	13	35,800	23	1	69	4	.....	3	1	Normal.....	468	793	Amber, clear....	59	None.	+ Slight.	Do.
21	73	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
25	67	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
28	76	6,120,000	78	19,200	30	6	54	9	.....	1	0	Anisocytosis....	497	815	Amber, clear....	61	None.	+ Slight.	Do.
32	72	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
35	67	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
39	64	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
44	60	5,120,000	18	8,800	16	7	65	8	.....	4	1	Anisocytosis....	571	852	Amber.....	67	None.	+ Slight.	Do.
47	48	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
51	44	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
58	55	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
77	64	4,880,000	.....	16,400	7.5	8	77	4	3.5	.....	5	Anisocytosis....	546	840	Amber, clear....	65	None.	Negative.	Do.
86	56	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
88	53	3,640,000	.....	20,800	10.5	2.5	86	.....	.....	1	0	Slight anisocytosis.	.....	.....	Amber, clear....	72	None.	Negative.	Do.
93	41	2,944,000	.....	39,000	13.5	1	83	.....	.....	2.5	6	Anisocytosis....	584	789	.....do.....	74	..do...	...do.....	Do.
99	33	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
103	34	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
107	44	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
112	62	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
115	62	4,688,000	.....	13,800	16.5	3.5	76.5	1.5	2	.....	2	Anisocytosis, slight poikilocytosis.	.....	.....	Clear.....	66	.....	.....	.....
119	55	4,528,000	.....	14,600	19.5	3.5	77	.....	.....	.....	1	Anisocytosis....	461	659	.....do.....	70	.....	.....	.....
123	48	3,536,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	75	.....	.....	.....

November 20, 1918.—Autopsy.—Dog is fairly well nourished. Extensive superficial ulceration of oral mucous membrane. Mucous membrane comes away in long shreds. Conjunctivae are intact. No icterus. Serous cavities normal. Pericardial and omental fats are normal in color. Heart and lungs normal. Stomach and intestines are normal. Pancreas, adrenals, and kidneys normal. Spleen is normal in size. On section deep brownish red in color. The Malpighian bodies are inconspicuous. Microscopically the pulp is heavily sprinkled with phagocytes loaded with coarsely granular hemosiderin. Mesenteric lymph glands are normal except for slight increased pigmentation. Bone marrow of femur is mottled grayish pink and brownish red. Microscopically very cellular and heavily sprinkled with pigment-holding phagocytes. Liver normal in size, rather firm. The capsule is thin. On section the lobules are distinct, the centers are more opaque and lighter in color than the peripheries. Gall bladder and bile ducts are normal. Microscopically the liver cells about the efferent veins contain fat droplets. The capillaries contain many endothelial cells loaded with hemosiderin.

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TABLE 6.

[20 mg. T. N. T. (No. 7 pure) per kilo, per os. Total amount T. N. T. given=14.2 grams.]

DOG 34.

[Mixed diet 9 days before beginning experiment.]

Day of experiment.	Food eaten daily (gms.).	T. N. T. given.	Body weight.	Clinical symptoms.		Urine.		Feces.	Remarks.
				Character of mucous membranes.	Incoordination.	Bile pigment.	Webster's reaction.		
		Mg.	*Kilos.*						
1	250 bread, 250 milk, 100 meat	356	17.8	Normal	None	None		Diarrhea	Adult cur. Male. Active and normal.
2	None			do	Marked				Salivation.
4–6	125 bread, 125 milk, 50 meat	356	16.4	do	do	+++	+Slight	Soft	Slight salivation.
7–9	do	356	16.1	Slight cyanosis	Present	+	Negative	Diarrhea	
11–16	No bread, no milk, 90 meat	356	15.2	Normal	Slight	+Slight	do	do	Do.
18–23	75 bread, 75 milk, 70 meat	356	13.9	do	do	None	do	do	
25–30	200 bread, 200 milk, 50 meat	356	12.8	do	Slight weakness	do	do	do	Apparently sick.
32–37	do	356	11.5	Pale, slight cyanosis	Slight	+	do	do	Extensive mange. Droopy. Slight salivation.
39–44	75 bread, 75 milk, 40 meat	356	10.3	Pale	do	None	do	do	Purulent conjunctivitis. Weaker. Extensive mange.
46–47	No bread, no milk, 50 meat	356	9.1	do	Marked	do	do	do	Extensive emaciation. Weak. Conjunctivitis. Mange.
48	None	356	8.9						3 p. m. found dead.

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Day of experiment.	Hb.	Red cells per c. mm.	Reticulated reds.	White cells per c. mm.	Differential count.					Nucleated reds.	Character of reds.	Blood volume.		Plasma.				Clot.
					Small monos.	Large monos.	Pmn. n.	Pmn. eos.	Tr.			Plasma.	Total.	Character.	Per cent.	Hemolysis.	Webster's reaction.	
	P. ct.				*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*			*c. c.*	*c. c.*					
1	94	6,175,000	1	20,600	12	1	74	9	4	0	Normal	782	1,396	Water, clear	56	None	Negative.	Firm.
4	88																	
9	59																	
14	64	5,240,000	12	24,800	6	1	89	2	2	5	Anisocytosis, basophilia.	715	1,117	Amber, clear	64	None	+	Do.
19	69																	
23	74																	
27	81	7,064,000	14	11,800	9	2	83	4	2	2	Anisocytosis	650	1,250	Amber, clear	52	None	+Slight	Do.
30	84																	
31	74																	
33	69																	
37	55																	
41	55	4,768,000	54	27,400	3	2	93	1	1	3	Anisocytosis	502	756	Light brown, clear.	66	None	+Slight	Do.
44	47																	

September 4, 1918.—Autopsy.—Animal is extremely emaciated. Very extensive mange. Mucous membrane of mouth and conjunctivae are intact. No icterus. Subcutaneous and omental fats are scanty and normal in color. Serous cavities normal. Heart and lungs normal. Stomach and intestines normal. Pancreas, adrenals, and kidneys normal. Spleen is normal in size. On section it is uniformly brownish red in color. Microscopically the pulp contains numerous phagocytes loaded with hemosiderin. Bone marrow is uniformly deep red in color ard extends high into the shaft of the femur. Microscopically it is very cellular and contains numerous pigment-holding phagocytes. Liver is normal except for some increased pigmentation. Gall bladder and bile ducts are normal. Microscopically the liver is fairly normal looking and shows no scarring. Many of the specialized endothelial Kupffer cells are swollen and contain a coarsely granular light brown iron-containing pigment.

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TABLE 7.

[20 mg. T. N. T. (No. 4 crude) per kilo, subcutaneously. Total amount T. N. T. given=20 grams.]

DOG 30.

[Mixed diet 7 days before beginning experiment.]

Day of experiment.	Food eaten daily (gms.).	T. N. T. given.	Body weight.	Temperature (rectal).	Clinical symptoms.		Urine.			Feces.	Remarks.
					Character of mucous membranes.	Incoordination.	Color.	Bile pigment.	Webster's reaction.		
		Mg.	*Kilos.*	°*C.*							
1	None	278	13.9	.....	Normal	None	.....	None	Negative	.....	Young adult bull mongrel, bitch. Active and normal. T. N. T administered in 9.3 c. c. olive oil.
2-4	....do	278	13.9	.....	Cyanosis	Slight	.....	+Slight	....do	Soft	
6-11	200 bread, 200 milk, 100 meat.	278	12.8	38.3	Slight cyanosis	...do	.....	None	.....	...do	Slight salivation.
13-18	16 bread, 16 milk, 100 meat	278	12.3	38.4	....do	...do	.....	....do	.....	Diarrhea	Do.
20-25	25 bread, 25 milk, 50 meat.	278	11.6	38.2	....do	...do	.....	....do	+Slight	...do	Do.
27-32	200 bread, 200 milk, 50 meat.	278	11	.....	Pale	None	.....	....do	Negative	...do	
34-39	250 bread, 250 milk, 50 meat.	278	10.9	.....	Slight cyanosis, slight icterus?	...do	.....	....do	...do	...do	Do.
41-46	....do	278	11.7	.....	....do	...do	.....	....do	.....	...do	Do.
48-53	275 bread, 275 milk, 50 meat.	278	11.8	.....	Slight cyanosis	...do	.....	....do	.....	...do	Do.
55-60	....do	278	11.6	.....	Slight cyanosis, very pale.	...do	Dark brown	....do	Negative	Soft	Salivation. Well nourished.
62-67	....do	278	11.8	.....	....do	...do	Yellow	....do	...do	...do	
69-74	....do	278	11.9	.....	Very pale	Slight	Brown	....do	...do	...do	Lively. Fairly well nourished.
76-81	200 bread, 200 milk, 50 meat.	278	11.6	.....	....do	...do	....do	+	...do	...do	
83-84	....do	278	10.8	.....	Oral mucous membranes ulcerated.	...do	....do	+Slight	.....	...do	
85-86	75 bread, 75 milk, 25 meat.	.....	.....	.....	....do	...do	Dark brown	+	Negative	....do	
87	.....	.....	9.4	.....	Oral mucous membranes intact.	.....	Red brown	Post mortem, none.	.....	.....	9 a. m. very weak; can hardly stand. 12 m. found dead.

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Day of experiment.	Hb.	Red cells per c. mm.	Reticulated reds.	White cells per c. mm.	Differential count.					Nucleated reds.	Character of reds.	Blood volume.		Plasma.				Clot.
					Small monos.	Large monos.	Pmn. n.	Pmn. eos.	Tr.			Plasma.	Total.	Character.	Per cent.	Hemolysis.	Webster's reaction.	
	Per ct.				*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*			c. c.	c. c.					
1	85	6,112,000	.....	19,000	12	4	77	4	3	2	Normal.....	580	1,018	Water clear.....	57	None.	Negative.	Firm.
6	67	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
11	56	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
14	50	4,824,000	2	10,800	19	1	78.5	1	.5	0	Anisocytosis.....	557	819	Amber, clear.....	68	None.	Negative.	Do.
21	60	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
25	63	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
28	61	5,320,000	38	18,800	10	3	82	4	1	1	Normal.....	533	820	Amber, clear.....	65	None.	+ Slight.	Do.
32	58	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
35	61	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
39	55	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
44	58	5,000,000	12	13,200	17	1	77	4	1	2	Normal.....	538	815	Light brown, clear..	66	None.	Negative.	Do.
48	60	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
51	54	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
58	56	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
70	58	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
75	47	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
78	41	2,640,000	.....	19,200	10.5	1	85.5	.....	3	1	Marked anisocytosis, poikilocytosis.	568	800	Amber, clear.....	71	None.	Negative.	Do.
85	41	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
87	40	2,896,000	.....	32,400	3.5	1	93	.....	2.5	6	Anisocytosis.....	448	659	Amber, clear.....	68	None.	Negative.	Do.

October 11, 1918.—Autopsy.—Animal is somewhat emaciated. No icterus. Subcutaneous and omental fats are quite abundant and normal in color. Serous cavities normal. Neck organs normal. Pancreas, adrenals, and kidneys are normal in gross and in sections. Spleen is large and quite firm. The cut section shows increased pigmentation. Microscopically the pulp contains a maximum number of hemosiderin-containing phagocytes. Many megalocaryocytes. The Malpighian bodies are normal. Mesenteric lymph glands are normal. Bone marrow of femur is uniformly dark red and granular. Microscopically it shows an intense regenerative hyperplasia. A few mononuclear phagocytes containing hemosiderin. Liver is normal in size. Capsule is thin. On section the lobules are distinct. Microscopically the liver cells are quite normal. A few of the endothelial Kupffer cells contain hemosiderin.

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TABLE 8.

[5 mg. T. N. T. (No. 6 crude) per kilo, per os. Total amount T. N. T. administered = 11.55 grams.]

DOG 40.

[Meat and calcium phosphate diet. 20 gm. calcium phosphate per kilo meat.]

Day of experiment.	Food eaten daily.	T. N. T. given.	Body weight.	Clinical symptoms.		Urine.			Feces.	Remarks.
				Character of mucous membranes.	Incoordination.	Color.	Bile pigment.	Webster's reaction.		
	Gms.	*Mg.*	*Kilos.*							
1	475	755	15.1	Normal	None				Soft	Adult hound, mongrel, male Active and normal.
3–8	375	755	14.7	do	Marked		+	Negative	do	Salivation. Vomited.
10–15	340	755	14.6	do	Present		+ Slight	do	do	
17–22	400	755	14.7	do	do		+	+ Slight	do	Slight salivation.
24–29	500	755	14.8	do	do		+	Negative	Hard	Droopy. Acts as if blind.
31–36	490	755	15.5	Pale	Slight		+ Slight		do	Tendency to walk in a circle. Droopy.
38–43	480	755	15.9	do	Present		None		None	Lively. General condition improved.
45–50	480	755	16.3	do	None		+ Slight		Hard	Well nourished.
52–57	470	755	16.3	do	do	Light brown	++	Negative	do	
59–64	470	755	16.4	do	do	do	+	do	do	
66–71	375	755	16.4	do	do	Yellow	+ Slight	do	do	Lively. Fat.
73–78	375	755	16.3	do	Slight	Light brown	+	do	Soft	
80–85	380	755	16.4	do	None	do	+	do	Hard	Much more lively than at the beginning of experiment.
87–92	380	755	16.4	do	Slight	Yellow	+ Slight		do	Marked salivation.
94–99	395	755	16.3	do	do	Light brown	++		do	
101–106	380	755	16.7	do	do	do	+		do	
108–113	425	755	17	do	None	Brown	++		do	
116–120	390	755	16.7	Very pale	do	do	++		do	In excellent condition.
122–127	435	755	16.3	do	do	do	+		do	
129–134	390	755	16.5	do	do	Light brown	+		do	
136–138	365	755	16.3	do	do	do	+		do	
140–141	380	755	16.1	do	do	Yellow	None		do	In excellent condition. Fat.
143–148	370	755	16.5	do	do	Light brown	+ Slight		do	
[illegible]	375	755	16.5	do	do	Brown	++		do	
[illegible]	375	755	15.9	do	do	Light brown	++		do	
[illegible]	420	755	16.1	do	do	do	++		do	
[illegible]	380	755	16.2	do	do	Brown	+		do	
[illegible]	370	755	15.7	do	do	Light brown	+		do	
[illegible]	375	755	16	do	do	do	+ Slight		do	Rapid decline in condition.
[illegible]	375	755	16	do	do	do	do		do	Do.
[illegible]	360	755	15.9	do	do					Found dead.
[illegible]	[illegible]		15.6							

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Day of experiment.	Hb.	Red cells per c. mm.	Reticulated reds.	White cells per c. mm.	Differential count.						Nucleated reds.	Character of reds.	Plasma.				Clot.
					Small monos.	Large monos.	Pmn. n.	Pmn. eos.	Pmn. bas.	Tr.			Character.	Per cent.	Hemolysis.	Webster's reaction.	
	Per ct.				*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*							
1	100	8,256,000	1	15,800	14	7	72	3	.....	4	0	Normal.....	Water, clear	46	None..	Negative..	Firm.
3	96	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	49	.....	.....	
8	76	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Amber, clear.....	56	None..	Negative..	Do.
14	76	5,040,000	8	14,800	9	2	85	2	.....	2	43	Slight basophilia.....	Light brown, clear....	53	...do...	...do.....	Do.
18	79	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Amber, clear.....	57	...do...	...do.....	Do.
22	68	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Amber, slight lipaemia	64	...do...	...do.....	Do.
28	83	7,144,000	6	7,200	6	5	78	10	.....	1	9	Anisocytosis.....	Water, clear.....	62	...do...	...do.....	Do.
32	78	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....do.....	57	...do...	...do.....	Do.
36	75	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Amber, clear.....	58	...do...	...do.....	Do.
42	81	5,904,000	3	8,400	9	4	76	10	.....	1	0	Slight anisocytosis	.....do.....	55	...do...	...do.....	Do.
48	70	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Water, clear.....	60	...do...	...do.....	Do.
55	72	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Lipaemia ++.....	58	...do...	...do.....	Do.
67	82	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Amber, clear.....	55	...do...	...do.....	Do.
72	68	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
74	73	5,656,000	.....	12,000	2.5	.....	88.5	.5	6	2.5	2	Slight anisocytosis....	Amber, clear.....	56	None..	Negative..	Do.
79	72	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....do.....	60	...do...	...do.....	Do.
83	69	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....do.....	62	...do...	...do.....	Do.
88	77	5,996,000	.....	9,800	11.5	1.5	85.5	1.5	.....	.....	0	Normal.....	Water, clear.....	59	...do...	...do.....	Do.
93	64	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Amber, slight lipaemia	62	.....	.....	
96	61	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Amber, clear.....	62	.....	.....	
100	66	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	71	Slight	.....	
104	53	3,888,000	.....	6,400	17	2	79	.....	1	1	40	Anisocytosis.....	Lipaemia, turbid.....	80	.....	.....	Do.
110	63	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Clear.....	59	.....	.....	
114	54	4,504,000	.....	26,000	46	4	50	.....	.....	.....	586	Anisocytosis.....	Amber.....	67	.....	.....	
128	49	4,368,000	.....	6,800	9	1	88.5	1	.....	.5	16	Marked anisocytosis, poikilocytosis.	Amber, clear.....	71	.....	.....	Do.
138	43	2,616,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
149	43	2,848,000	.....	12,400	16	3	79	.....	.....	2	72	Marked anisocytosis, poikilocytosis.	Amber, clear.....	70	.....	.....	Do.
161	32	2,200,000	.....	17,000	.....	.....	.....	.....	.....	.....	.....	.....	Slight lipaemia.....	74	.....	.....	Do.
180	40	3,232,000	.....	15,400	10	2	83.5	.5	1.5	2.5	14	Marked anisocytosis, poikilocytosis.	Lipaemia ++.....	78	.....	.....	Do.

February 10, 1919—Autopsy.—Dog is well nourished. Oral mucous membrane and conjunctivae are intact. No icterus. Subcutaneous and omental fats are abundant and normal in color. Pericardial sac is distended with a slightly turbid colorless fluid. Some increase of pleural fluid. All organs are pale and anemic. Heart is distended, pale, and filled with a goose-fat clot. Blood is watery. Lungs are oedematous. Pancreas and adrenals are normal. Kidneys are swollen, pale, and somewhat oedematous. Microscopically many of the glomerular capsules contain coagulated fluid. The tubular epithelium is swollen and granular. There are many hyaline casts in the collecting tubules. Stomach is normal. Duodenum is filled with bile-stained fluid. Mucosa is intact and normal. No congestion. Lower, small and large intestines are normal. Spleen is swollen. On section the parenchyma is velvety and deep red in color. The Malpighian bodies are inconspicuous. Microscopically the venules and pulp are engorged. The pulp contains numerous megalocaryocytes, normoblasts and pigment-holding phagocytes. Mesenteric lymph glands are nearly normal. The sinuses are filled with coagulated fluid containing a few wandering cells. Bone marrow of femur is intensely hyperplastic and contains few pigmented phagocytes. Liver is enlarged and pale and rather firm. On section the lobules are very conspicuous. The gall bladder and bile ducts are normal. Microscopically there is an extensive central fatty change involving three-fifths of all the liver cells. The liver cells about the portal structures are swollen, granular, and contain many small fat droplets. No scarring. Few pigmented phagocytes. Bile structures unchanged.

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TABLE 9.

[5 mg. T. N. T. (No. 7 pure) per kilo, subcutaneously. Total amount T. N. T. administered=11.438 grams.]

DOG 38.

[Meat and calcium phosphate diet. 20 gm. calcium phosphate per kilo meat.]

Day of experiment.	Food eaten daily.	T.N.T. given.	Body weight.	Temperature rectal.	Clinical symptoms.		Urine.			Feces.	Remarks.
					Character of mucous membranes.	Incoordination.	Color.	Bile pigment.	Webster's reaction.		
	Gms.	*Mg.*	*Kilo.*	*°C.*							
1	.....	66.5	13.3	.....	Normal.....	None.....	.....	None....	Negative	.....	Adult fox terrier mongrel, male.
2	.....	66.5	.....	.....	Slight cyanosis.....	Present...	.....				T. N. T. administered in 2.22 c. c. refined corn oil.
3	488	66.5	.....	.....	Normal.....	Marked...	.....	+	...do.....	Soft.....	Salivation.
5–10	380	66.5	12.4	38.6	Slight cyanosis.....	Present...	.....	.....	.....	.....	Do.
12–17	400	66.5	12.0	38.2	.....do.....	...do.....	.....	+++	+Slight..	Soft.....	
19–24	400	66.5	12.2	38.2	Marked cyanosis.....	Marked...	.....	+	...do.....	Hard....	Slight salivation.
26–31	495	66.5	13.1	.....	Slight icterus.....	None.....	.....	+	Negative	None....	Do.
33–38	490	66.5	13.6	.....	Slight cyanosis, slight icterus.....	Slight....	.....	++	...do.....	Hard....	Do.
40–45	475	66.5	14.1	.....	Marked cyanosis, slight icterus.....	...do.....	.....	+	...do.....	...do....	Do.
47–52	475	66.5	14.6	.....	Marked cyanosis.....	...do.....	.....	++	.....	...do....	Do.
54–59	480	66.5	14.7	.....	Slight cyanosis, slight icterus.....	None.....	.....	+	.....	...do....	Slight salivation. Well nourished.
61–66	425	66.5	14.2	.....	Slight icterus.....	...do.....	Dark brown....	++	Negative	...do.....	Tongue brownish red.
68–73	375	66.5	13.9	.....	Slight cyanosis, slight icterus.....	Marked...	Yellow.....	++	...do.....	Soft.....	Tongue normal.
75–80	390	66.5	.....	.....	Slight icterus.....	None.....	Brown.....	++	...do.....	Hard.....	Lively. Fat. Salivation.
82–87	390	66.5	14.1	.....	Pink.....	...do.....	Dark brown....	++	...do.....	...do....	Salivation.
89–94	390	66.5	13.9	.....	Normal.....	Slight....	.....do.....	++	.....	...do....	Well nourished.
96–101	385	66.5	13.5	.....	.....do.....	None.....	.....do.....	++	.....	...do....	Active. Well nourished.
103–108	380	66.5	13.9	.....	.....do.....	...do.....	.....do.....	++	.....	...do....	In good condition.
110–115	400	66.5	13.6	.....	.....do.....	...do.....	.....do.....	+++	.....	...do....	
117–122	390	66.5	13.2	.....	.....do.....	...do.....	Reddish brown....	+++	.....	...do....	
124–129	450	66.5	13.2	.....	.....	.....	.....do.....	+++	.....	...do....	In excellent condition.
131–136	385	66.5	13.1	.....	.....	.....	Dark brown....	+++	.....	...do....	
138–143	380	66.5	13	.....	.....	.....	.....do.....	++	.....	...do....	
145–150	375	66.5	12.5	.....	.....	.....	.....do.....	+	.....	...do....	
152–157	375	66.5	12.7	.....	Pale pink.....	None.....	.....do.....	+	.....	...do....	
159–164	375	66.5	12.5	.....	Pale.....	...do.....	.....do.....	++	.....	...do....	In good condition. Fat.
166–171	375	66.5	12.7	.....	.....do.....	...do.....	Light brown....	+	.....	...do....	
							Dark brown....	++	.....	...do....	

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162–164	425	66.5	12.7	.....	Pale	None	.....	.....	Soft.
166–167	500	66.5	12.4	.....	do	do	.....	.....	do.
169–171	380	66.5	13	.....	do	do	.....	.....	do.
173–178	365	66.5	12	.....	do	do	Dark brown	.....	do.
180–185	360	66.5	11.4	.....	do	do	do	+++	do.
187–192	370	66.5	10.6	.....	do	do	do	++	do.
194–199	325	66.5	10.3	.....	do	do	Light brown	+Slight	do.
201–205	240	66.5	10	.....	do	do	.....	.....	do.
206–217	270	.....	9.5	.....	do	do	.....	.....	do.
218–219	None.	.....	8.9	.....	Very pale	do	.....	.....	Very weak. Very extensive mange.
220	.....	.....	.....	.....	.....	.....	.....	.....	9 a. m. found dead.

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TABLE 9—Continued.

DOG 38—Continued.

Day of experiment.	Hb.	Red cells per c. mm.	Reticulated reds.	White cells per c. mm.	Differential count.						Nucleated reds.	Character of reds.	Plasma.				Clot.
					Small monos.	Large monos.	Pmn. n.	Pmn. eos.	Pmn. bas.	Tr.			Character.	Per cent.	Hemolysis.	Webster's reaction.	
	Per ct.				*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*							
1	106	7,792,000	1	15,600	23	.....	74	3	.....	.....	0	Normal.....	Water, clear.....	48	None..	Negative..	Firm.
5	94	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	46	.....	.....	
10	91	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Amber, clear.....	47	None.	Negative..	Do.
16	85	5,392,000	9	18,000	14	2	71	9	.....	4	99	Anisocytosis.....	Light brown, clear....	50	...do..	...do.....	Do.
20	93	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....do.....	48	...do..	...do.....	Do.
24	85	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....do.....	55	...do..	...do.....	Do.
30	88	7,240,000	5	14,800	17	6	70	5	.....	2	35	Anisocytosis, basophilia	Amber, clear.....	53	...do..	...do.....	Do.
35	83	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....do.....	53	...do..	...do.....	Do.
38	83	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Lipaemia++.....	51	...do..	...do.....	Do.
44	95	7,464,000	13	19,800	11	4	67	16	.....	2	28	Basophilia.....	Amber, clear.....	53	...do..	...do.....	Do.
50	78	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....do.....	59	...do..	...do.....	Do.
57	92	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....do.....	48	...do..	...do.....	Do.
69	84	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....do.....	57	...do..	...do.....	Do.
74	79	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
76	75	4,816,000	.....	25,200	7.5	1.5	88	.....	.....	3	75	Anisocytosis.....	Amber, clear.....	59	None..	Negative..	Do.
81	80	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....do.....	57	...do..	...do.....	Do.
85	79	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....do.....	58	...do..	...do.....	Do.
90	84	5,616,000	.....	20,600	21	1	74.5	1.5	0.5	1.5	67	Slight poikilocytosis...	Water, clear.....	53	...do..	...do.....	Do.
95	81	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Light brown.....	57	.....	.....	
99	65	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....do.....	69	.....	.....	
102	66	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Amber, clear.....	62	.....	.....	
106	66	5,568,000	.....	15,600	26	0.5	68.5	.....	1.5	3.5	61	Poikilocytosis.....	.....do.....	58	.....	.....	Do.
111	73	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....do.....	60	.....	.....	
116	73	5,248,000	.....	28,200	26	.....	74	.....	.....	.....	298	Anisocytosis, poikilocytosis.	Greenish yellow.....	62	.....	.....	Do.
130	68	6,648,000	.....	24,600	17.5	9	72	.....	.5	1	90	Anisocytosis.....	Amber, clear.....	66	.....	.....	
140	47	3,048,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
151	51	3,384,000	.....	20,000	14	3	81	.....	.....	2	44	Anisocytosis, poikilocytosis.	Amber, clear.....	66	.....	.....	Do.
163	47	3,088,000	.....	11,400	.....	.....	.....	.....	.....	.....	.....	.....	.....do.....	71	.....	.....	Do.
183	49	3,672,000	.....	25,000	7	2	83	6	1	1	92	Anisocytosis, poikilocytosis.	Lipaemia+++.....	66	.....	.....	Do.
212	45	3,072,000	.....	18,600	12	.....	85	.....	1	2	0	Anisocytosis.....	Lipaemia.....	73	.....	.....	Do.
219	27	1,624,000	.....	25,000	6.5	1	86.5	5.5	.....	.5	2	.....do.....	Lipaemia++.....	78	.....	.....	Do.

July 18, 1914.—Autopsy.—Dog is emaciated. Very extensive mange. Oral mucous membranes and conjunctivae are intact. Subcutaneous and omental fats are normal in color. No icterus. No excess of serous fluids. All organs are very anemic. Heart muscle is pale. Valves are normal. In the muscle of the left ventricle there is an opaque yellowish gray area of softening 1 centimeter in diameter and surrounded by a more translucent grayish brown margin. Microscopically the area of softening is filled with cell débris and leucocytes mainly mononuclears. It is surrounded by an area of necrosed muscle cells. Stomach and intestines are normal. Pancreas and adrenals are normal. Kidneys are normal in gross and in sections. Spleen is small, parenchyma is scanty and yellowish brown in color. Malpighian bodies are inconspicuous. Microscopically the pulp contains many phagocytes loaded with hemosiderin. The Malpighian bodies are small and some contain hyaline masses. Mesenteric lymph glands are normal. Bone marrow is mottled gray and brownish red. Microscopically it is hyperplastic and quite vascular. Little fat. Many pigmented phagocytes. Liver is normal in gross. Gall bladder and bile duct are normal. Microscopically the liver cells appear normal. No scarring. The capillaries contain a few hemosiderin-containing phagocytes.

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TABLE 10.

[5mg. T. N. T. (No. 7 pure) per kilo, per os. Total amount T. N. T. administered, 5.92 grams.]

DOG 41.

[Meat and calcium phosphate diet. 20 gm. calcium phosphate per kilo meat.

Day of experiment.	Food eaten daily.	T. N. T. given.	Body weight.	Clinical symptoms.		Urine.			Feces.	Remarks.
				Character of mucous membranes.	Incoordination.	Color.	Bile pigment.	Webster's reaction.		
	Gms.	*Mg.*	*Kilos.*							
1	480	80	16	Normal	None				Diarrhea	Adult terrier mongrel, male.
3	400	80		do	Marked		++	Negative	Soft	Salivation.
4-8	375	80	15.3	do	Present		+	do	do	Salivation. Vomited on eighth day.
10-15	400	80	15.3	Slight cyanosis	Slight		None	do	do	
17-22	400	80	15.6	Normal	do		do	do	do	
24-29	400	80	16.1	do	None		+Slight	do	Hard	
31-36	480	80	16.2	Slight cyanosis	do		do	do	do	
38-43	490	80	16.8	Normal	do		do		Soft	In excellent condition.
45-50	490	80	16.6	Cyanosis	do		do		Hard	Well nourished.
52-57	475	80	16.6	Pale pink	do		++		Soft	
59-64	420	80	16.6	do	do	Light brown	+		do	
66-68	380	80	15.9	do	Present	do	++		do	Fat. Lively.
69-71	380	80	15.3	do	Marked	Light yellow	++	Negative	do	Salivation. Droopy. Fat.
73-78	265	80	14	Very pale pink	do	Brown	+		do	Very droopy. Discharge from nose on seventy-eighth day.
80-85	10	80	13.2	do	do	Light brown	+	Negative	Diarrhea	Dry exudate in nostrils. Still droopy.
87	None.	80	12.1	White	do	do	None		do	Moribund. Weak and cold. Can hardly stand.
88										9 a. m. found dead.

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TABLE 10—Continued

DOG 41—Continued.

Day of experiment.	Hb.	Red cells per c. mm.	Reticulated reds.	White cells per c. mm.	Differential count.						Nucleated reds.	Character of reds.	Plasma.				Clot.
					Small monos.	Large monos.	Pmn. n.	Pmn. eos.	Pmn. bas.	Tr.			Character.	Per cent.	Hemolysis.	Webster's reaction.	
	P.ct.				*P.ct.*	*P.ct.*	*P.ct.*	*P.ct.*	*P.ct.*	*P.ct.*							
1	92	10,656,000	1	13,000	28	4	63	5	.....	.....	0	Normal	Water, clear	47	None	Negative	Firm.
3	91	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	50	.....	.....	
8	89	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Amber, clear	52	None	Negative	Do.
14	88	6,488,000	5	12,800	20	1	77	.....	.....	2	0	Normal	Amber, lipæmia	54	...do	...do	Do.
17	88	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Amber, clear	53	...do	...do	Do.
22	83	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Amber, slight lipæmia	57	...do	...do	Do.
28	80	6,064,000	16	15,400	16	7	73	3	.....	1	18	Anisocytosis, basophilia.	Water, clear	58	...do	...do	Do.
32	86	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
36	81	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Amber, clear	55	...do	...do	Do.
42	81	6,344,000	2	15,200	25	1	71	2	.....	1	27	Anisocytosis, basophilia.	Water, clear	56	...do	...do	Do.
48	75	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Amber, clear	56	...do	...do	Do.
55	77	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Water, clear	57	...do	...do	Do.
65	78	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Lipæmia	58	...do	...do	Do.
72	33	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Amber, clear	59	...do	...do	Do.
74	35	2,496,000	.....	41,000	17	7.5	75.5	.....	.....	.....	407	Anisocytosis, poikilocytosis.	.....	.....	.....	.....	
77	19	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Amber, clear	79	None	Negative	Do.
78	20	1,248,000	.....	26,200	11.5	3	79	.....	0.5	6	50	Anisocytosis, poikilocytosis.	.....	.....	.....	.....	
80	20	1,304,000	.....	26,800	18	3	73	.....	.....	6	44	.....	Amber, clear	88	None	Negative	Do.
81	15	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
84	15	1,072,000	.....	39,200	12.5	.5	83	.....	.....	4	52	Anisocytosis, poikilocytosis.	.....do	90	...do	...do	Do.
87	15	1,008,000	.....	9,200	21.5	.5	74	.....	.....	4	102	.....do	.....do	91	...do	...do	Do.
													.....	.....	.....	.....	
													Amber	92	...do	...do	Do.
													Yellow	92	...do	...do	Do.

October 15, 1918.—Autopsy.—Dog is fairly well nourished. No icterus. Oral mucous membrane and conjunctivae are intact. Serous cavities are normal. Extreme pallor of all organs. Heart is normal. Lungs show a few small areas of bronchopneumonia. Stomach and intestines normal. Pancreas and adrenals are normal. Kidneys are swollen and very pale. Microscopically the tubular epithelium is swollen and granular. The lumina of the convoluted tubules are almost obliterated. Many glomerular capsules contain coagulated fluid. Spleen is swollen and fragile. On section the pulp is velvety and uniformly brownish-red in color. Malpighian bodies inconspicuous. Microscopically most of the Malpighian bodies contain hyaline masses. Some are completely obliterated. The pulp contains many giant cells, myelocytes, normoblasts, and pigment-holding phagocytes. Mesenteric lymph glands are normal in gross and in sections. Bone marrow is brownish red, granular, and extends high into the shaft of the femur. Microscopically it is densely cellular and is heavily sprinkled with large phagocytes loaded with a yellowish-brown pigment. The fat cells have completely disappeared. Liver is swollen and very pale. Capsule is thin. On section the lobules are distinctly outlined with opaque yellowish-brown centers and more translucent brownish-red peripheries. Gall bladder is distended with 31 c. c. very dark bile. Gall ducts are normal. Microscopically the liver cells about the efferent veins are loaded with fat droplets. The marginal cells are swollen and granular. Capillaries contain many normoblasts and hemosiderin-holding endothelial cells. No scarring. Bile ducts normal.

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TABLE 11.

[5 mg. T. N. T. (No. 6 crude) per kilo, subcutaneously. Total amount T. N. T. given=7.60 grams.]

DOG 11.

[Meat and calcium phosphate diet. 20 gm. calcium phosphate per kilo meat.]

Day of experiment	Food eaten daily.	T. N. T. given.	Body weight.	Temperature (rectal).	Clinical symptoms.		Urine.			Feces.	Remarks.
					Character of mucous membranes.	Incoordination.	Color.	Bile pigment.	Webster's reaction.		
	Gms.	*Mg.*	*Kilos.*	*° C.*							
1	.....	58.5	11.7	.....	Normal	None	.....	.....	.....	.....	Adult cur, bitch; T. N. T. administered in 1.95 c. c. refined corn oil.
2	.....	58.5	11.7	.....	Slight cyanosis	...do	.....	None	+	.....	
3	500	58.5	.....	.....	Normal	...do	.....	.....	.....	Soft	
5–10	365	58.5	11.7	38.5	Slight cyanosis	...do	.....	None	+	...do	Salivation.
12–17	310	58.5	11.3	38.2	...do	...do	.....	...do	+Slight	...do	Slight salivation.
19–24	385	58.5	11.4	38.3	Normal	Slight	Yellow	...do	...do	Diarrhea	Salivation.
26–31	405	58.5	11.2	.....	Slight cyanosis	None	.....	...do	Negative	Soft	
33–38	420	58.5	11.1	.....	...do	...do	.....	...do	+Slight	...do	Slight salivation; lively; fat.
40–45	390	58.5	11.2	.....	Normal	...do	.....	...do	...do	...do	In excellent condition.
47–52	385	58.5	10.9	.....	Very pale, slight cyanosis	...do	.....	...do	.....	Hard	Lively.
54–59	350	58.5	11	.....	Pale pink	...do	.....	...do	.....	...do	
61–66	335	58.5	10.7	.....	...do	...do	Dark brown	+	.....	...do	
68–73	335	58.5	10.6	.....	Pale pink, slight cyanosis	...do	Reddish brown	++	Negative	...do	Lively; well nourished.
75–80	315	58.5	9.7	.....	Pale pink	...do	Dark brown	+	...do	...do	
82–87	285	58.5	9.6	.....	...do	...do	...do	+Slight	...do	...do	Has great difficulty in using hind legs.
89–94	255	58.5	9.5	.....	...do	...do	...do	+	.....	...do	Marked salivation.
96–101	265	58.5	9.5	.....	Very pale	...do	Brown	None	.....	...do	
103–108	280	58.5	10.0	.....	...do	...do	...do	++	.....	...do	
110–115	280	58.5	10.3	.....	...do	...do	...do	+	.....	...do	
118–122	285	58.5	10.7	.....	...do	...do	Light brown	+Slight	.....	Soft	In good nutritional state.
124–129	295	58.5	10.6	.....	...do	...do	...do	None	.....	Hard	
131–133	285	58.5	10.7	.....	...do	...do	...do	+Slight	.....	...do	
135–136	270	58.5	10.6	.....	...do	...do	Dark brown	+	.....	...do	
138–143	275	58.5	10.5	.....	...do	...do	Yellow	+Slight	.....	...do	In fairly good condition; well nourished.
145–150	270	58.5	11.0	.....	...do	...do	...do	None	.....	...do	
152–154	260	58.5	10.9	.....	...do	...do	Light brown	+Slight	.....	...do	Refuses to walk; weak.
156	.....	.....	10	.....	.....	.....	.....	.....	.....	.....	8 a. m. found dead.

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TABLE 11—Continued.

DOG 11—Continued.

Day of experiment.	Hb.	Red cells per c. mm.	Reticulated reds.	White cells per c. mm.	Differential count.						Nucleated reds.	Character of reds.	Plasma.				Clot.
					Small monos.	Large monos.	Pmn. n.	Pmn. eos.	Pmn. bas.	Tr.			Character.	Per cent.	Hemolysis.	Webster's reaction.	
	Per ct.				*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*							
1	101	8,104,000	4	21,800	19	3	59	19	.....	.....	0	Normal.....	Amber, clear.....	50	None	Negative..	Firm.
5	79	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	60	.....	.....	.....
10	79	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Amber, clear.....	57	None..	Negative..	Do
16	91	6,688,000	20	16,400	20	6	58	13	.....	3	8	Normal.....	.....do.....	53	...do...	....do.....	Do.
19	92	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Lipaemia++.....	.....	.....	.....	.....
24	81	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Amber, clear.....	56	None..	Negative..	Do.
30	86	6,072,000	28	19,000	11	2	71	15	.....	1	0	Anisocytosis, basophilia.	.....do.....	57	...do...	....do.....	Do.
35	79	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Lipaemia.....	54	...do...	....do.....	Do.
38	71	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Amber, clear.....	61	...do...	....do.....	Do.
44	83	6,424,000	5	16,200	15	2	54	6	.....	23	1	Anisocytosis, basophilia.	.....do.....	48	...do...	....do.....	Do.
51	70	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....do.....	56	...do...	+ Slight	Do.
57	79	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Lipaemia+.....	53	...do...	Negative..	Do.
69	82	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Amber, clear.....	57	...do...	....do.....	Do.
76	75	5,938,000	.....	10,200	28	11	53	2	.....	6	16	Slight anisocytosis....	.....do.....	59	...do...	....do.....	Do.
81	76	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....do.....	56	...do...	....do.....	Do.
85	79	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....do.....	56	...do...	....do.....	Do.
90	78	6,024,000	.....	11,600	10	1.5	88	.....	.....	.5	0	Slight anisocytosis....	Lipaemia++.....	54	...do...	....do.....	Do.
95	66	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Amber, slight lipaemia	61	.....	.....	.....
98	71	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Water, clear.....	57	.....	.....	.....
102	76	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....do.....	58	.....	.....	.....
105	66	5,352,000	.....	15,800	19.5	2	75.5	.....	.....	3	1	Normal.....	Lipaemias.....	62	.....	.....	.....
[illegible]	58	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Water, clear.....	68	.....	.....	.....
[illegible]	57	4,720,000	.....	10,600	21	10	66	1.5	1.5	.....	0	Normal.....	Amber, clear.....	70	.....	.....	.....
[illegible]	63	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	61	.....	.....	.....
[illegible]	[illegible]	4,668,000	.....	23,600	21.5	2.5	75	.....	.....	1	6	Anisocytosis, slight poikilocytosis.	Amber, slight lipaemia	63	.....	.....	.....
[illegible]	[illegible]	4,244,000	.....	20,800	11	4	84	.....	.5	.5	11	Anisocytosis, poikilocytosis.	.....do.....	73	.....	.....	.....

[illegible] 20, 1918.—*Autopsy.*—Dog is well nourished. No icterus. Subcutaneous fat is normal in color. Lungs show a few small areas of bronchopneumonia. Stomach and intestines appear normal. Kidneys are pale and swollen. Microscopically the tubular cells are swollen and granular. A few of the glomerular capsules contain coagulated fluid. Many of the lumina of the collecting tubules are filled with red cells. Spleen is small. Pulp velvety. Microscopically the venules and pulp are engorged. The pulp contains many megalocaryocytes, normoblasts and a few hemosiderin-holding phagocytes. Bone marrow of femur is dark red, solid, and granular. Microscopically very hyperplastic. Very few fat cells. No pigmented phagocytes. Liver is very pale. Capsule is thin. Lobulation is distinct. Gall bladder and bile ducts normal. Microscopically there is an extensive central fatty change. The marginal cells are swollen and granular. No scarring. Bile structures unchanged.

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TABLE 12.

1 mg. T. N. T. (No. 2 crude) per kilo, per os. Total amount T. N. T. given 16.46 grams.]

DOG 3.

[Meat diet followed by bread and milk.]

Day of experiment.	Food eaten daily.	T.N.T. given.	Body weight.	Temperature (rectal).	Clinical symptoms.		Urine.					Feces.	Remarks.
					Character of mucous membranes.	Incoordination.	Color.	Albumin.	Fehling's test.	Bile pigment.	Webster's reaction.		
	Gms.	*Mg.*	*Kilos.*	*° C.*									
1	492	305	20.3		Normal	None						Diarrhea	Adult mongrel hound, bitch. Given, per os, T. N. T. No. 2 crude 15 mgs. per kilo body weight.
2	190		20	38.8	Cyanosis	Marked	Dark red brown.	None	Negative	None	+Slight	do	Vomited.
3–7	70		18.6	38.1	Blanched	do	Dark amber	do	do	+	Negative	None	
8–12	230		18.2	38.2	Pale pink	Slight	Amber	+	do	None	do	do	
13	498	202	18.1	37.8	do	do	Light amber	+		+	do	Diarrhea	Given, per os, T. N. T. No. 2 crude 10 mgs. per kilo body weight.
14	225			38.2	do	Marked	Dark amber	None	Negative	None	do	None	
15	370	202		38.1	do	do	do	do	do	do	do	Hard	
17	225	202	17.8	38.2	do	do	Amber	do	do	do	do	Soft	
19	10	202	17.7	37.8	do	Slight	do	do	do	do	do	Hard	
21–22	455	202	17.4	38.1	do	do	do	do	do	do	++	do	
24	365	202		37.7	do	Present	do	do	do	do	++	Diarrhea	
26	500	202		37.6	do	Slight	do	do	do	do	+	do	
28	578	202	17.8	37.9	Normal	do	Reddish brown	do		do	+	do	
30–31	430	202	17.8	38.6	Normal, slight cyanosis.	do	do	do	Negative	do	+	do	
33–38	360	202	17.7	38.1	Normal	do	Dark amber	do	do	do	Negative	do	
40–45	375	202	17.8	38.2	do	None	Amber	do	do	do	do	do	
47–52	450	202	19	38.4	do	Slight	Dark amber	do	+	do	+Slight	do	
54–59	385	202	18.6	38	do	None	Amber	do	Negative	do	Negative	do	
61–63	385	202	18.5	38.1	do	do	do	do	do	do	do	do	
65–66	390	202	18.7	37.9	do	do			do	do	do	do	
68–73	375	202	18.9	38	Pale pink	do						do	
75–80	430	202	18.3	38.3	do	do				None	do	Soft	

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TABLE 12—Contfnued.

DOG 3—Continued.

Day of experiment.	Food eaten daily.	T. N. T. given.	Body weight.	Temperature (rectal).	Clinical symptoms.		Urine.					Feces.	Remarks.
					Character of mucous membranes.	Incoordination.	Color.	Albumin.	Fehling's test.	Bile pigment.	Webster's reaction.		
	Gms.	*Mg.*	*Kilos.*	*° C.*									
82–87	350.....	202	17.4	38.5	Normal.....	None.....	.....	.....	.....	None....	Negative..	Diarrhea..	
89–94	375.....	202	17.1	.....	.....do.....	...do.....	.....	.....	.....	...do....	...do.....	...do.....	Salivation.
96–101	475.....	202	17.4	.....	.....do.....	Slight.....	.....	.....	.....	...do....	...do.....	...do.....	Slight salivation.
103–108	500.....	202	17.3	.....	.....do.....	...do.....	.....	.....	.....	...do....	...do.....	...do.....	Do.
110–112	470.....	202	17.3	.....	.....do.....	...do.....	.....	.....	.....	...do....	...do.....	...do.....	Fairly well nourished. Lively. Slight salivation.
113	.....	202	.....	.....	.....do.....	None.....	.....	.....	.....	.....	.....	.....	
	[Diet changed to bread and milk. T. N. T. discontinued.]												
114–159	375 bread, 375 milk.	.....	18.3	.....	Normal.....	None	.....	.....	.....	None....	Negative..	Hard.....	
160–163	.....do.....	.....	16.7	.....	Extensively ulcerated.	...do.....	.....	.....	.....	.....	.....	.....	Marked salivation.
166–168	18 bread, 18 milk.	.....	13.5	.....	.....do.....	...do.....	.....	.....	.....	None....	Negative..	Soft.....	Very weak. Marked salivation.
169	None.....	.....	13.1	.....	.....do.....	...do.....	.....	.....	.....	.....	.....	.....	2 p. m., found dead.

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Day of experiment.	Hb.	Red cells, per c. mm.	Reticulated reds.	White cells per c. mm.	Differential count.						Nucleated reds.	Character of reds.	Blood volume.		Plasma.				Clot.
					Small monos.	Large monos.	Pmn. n.	Pmn. eos.	Pmn. bas.	Tr.			Plasma.	Total.	Character.	Per cent.	Hemolysis.	Webster's reaction.	
	P. ct.				*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*			*c. c.*	*c. c.*					
1	98	5,288,000	.....	12,600	.....	.....	.....	.....	.....	.....	.....	Normal.....	856	1,529	Slight lipaemia..	56	None.	.....	Firm.
6	104	5,784,000	.....	14,400	.....	.....	.....	.....	.....	.....	.....	....do.....	697	1,291	Light brown....	54	...do..	.....	Do.
13	90	4,376,000	.....	12,200	.....	.....	.....	.....	.....	.....	.....	Anisocytosis.....	800	1,333	.....	60	...do..	.....	Do.
19	94	4,384,000	.....	11,400	.....	.....	.....	.....	.....	.....	.....	....do.....	779	1,298	Lipaemia.....	60	...do..	Negative.	Do.
33	94	5,440,000	3	9,400	13	20	59	.....	.....	8	0	Normal.....	743	1,486	Water, clear.....	50	...do..	+?.....	Do.
51	87	5,304,000	6	9,200	16	8.5	62.5	7	.....	6	36	Slight anisocytosis	760	1,434	Water, lipaemia.	53	...do..	+.....	Do.
61	108	6,407,000	20	15,400	13	9	69	7	.....	2	17	Basophilia, slight anisocytosis.	791	1,521	Water, clear.....	52	...do..	+.....	Do.
68	87	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
72	78	4,832,000	52	21,600	13	11	57	12	.....	7	168	Slight anisocytosis, basophilia.	772	1,331	Amber, clear....	58	None.	+Slight..	Do.
79	65	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
84	77	6,056,000	41	26,800	8	7	81	3	.....	1	329	Anisocytosis, basophilia.	782	1,261	Amber, clear....	62	None.	+Slight..	Do.
94	86	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
99	85	6,584,000	42	15,000	14	.....	76	8	.....	2	4	Anisocytosis, basophilia.	752	1,274	Amber, clear....	59	None.	+Slight..	Do.
112	64	5,040,000	32	18,400	8	2	78	12	.....	.....	64	....do.....	769	1,221	.....do.....	63	...do..	+.....	Do.
118	70	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
122	85	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
128	89	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Water, clear.....	50	None.	.....	Do.
133	91	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Negative.	
145	102	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
150	94	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
153	100	7,080,000	.....	9,200	9	6.5	63.5	.....	3.5	17.5	0	Normal.....	748	1,526	Amber, clear....	49	None.	Negative.	Do.
161	97	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
166	108	7,408,000	.....	5,000	21	.....	74	.....	.....	5	0	Normal.....	519	1,236	Amber, clear....	42	None.	Negative.	Do.
168	110	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

October 17, 1918.—Autopsy.—Dog is poorly nourished. Skin is intact and apparently normal. Oral mucous membrane, including the under surface and sides of the tongue are superficially ulcerated. The mucous membrane comes away in long shreds leaving a raw and injected surface. Conjunctivæ are intact. Subcutaneous and omental fats are normal in color. No icterus. No excess of serous fluids. Heart and lungs are normal. Stomach contains bile-stained mucus. The mucosa is intact and normal. The duodenum and upper half of jejunum show a swollen deep red mucosa. The mucosa is covered with a yellowish brown slimy mucus. Pancreas and adrenals are normal. Kidneys are congested. Mesenteric lymph glands normal. Spleen is not enlarged. On cut section the pulp shows increased pigmentation. Microscopically the pulp is rarefied and spongy. Contains many phagocytes loaded with a light brown iron containing pigment. Malpighian bodies are normal. Bone marrow is deep red and granular. Microscopically it is very hyperplastic, vascular and contains few fat cells. Many hemosiderin-containing phagocytes. Liver is congested. Gall bladder contains 16 c. c. of very dark stringy bile. Microscopically the ver cells appear normal. Capillaries distended with red cells. No pigmented phagocytes. No scarring.

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TABLE 13.

[15 mg. T. N. T. (No. 2 crude) per kilo; per os. Total amount T. N. T. given=17.07 grams.]

DOG 4.

[Meat diet, bread and milk diet, and again meat diet.]

Day of experiment.	Food eaten daily.	T. N. T. given.	Body weight.	Temperature (rectal).	Clinical symptoms.		Urine.					Feces.	Remarks.
					Character of mucous membranes.	Incoordination.	Color.	Albumin.	Fehling's test.	Bile pigment.	Webster's reaction.		
	Gm. or c. c.	*Mg.*	*Kilos.*	*° C.*									
1	492	272	13.6	.....	Normal	None	Amber	None	Negative	None	Negative	Diarrhea	Old bull mongrel, bitch. Given per os. T. N. T. No. 2 crude, 20 mg. per kilo body weight.
2–7	325	.....	13.5	38.5	Blanched	Marked	...do	+	...do	...do	...do	Soft	
8	.....	272	.....	38.3	Pale	Slight	Light amber	+	...do	...do	...do	.....	
12–13	335	204	13.3	38.2	...do	...do	Amber	.....	.....	.....	++	Diarrhea	Given per os. T. N. T. No. 2 crude, 15 mg. per kilo body weight.
16–17	255	204	11.9	38.1	...do	...do	Light amber	None	Negative	None	+	...do	
19–20	65	204	11.7	38.5	...do	Marked	...do	...do	...do	...do	+	Hard	Six convulsions between 11.45 a. m. and 12.20 p. m.
23–24	420	204	11.5	38.6	...do	...do	...do	...do	...do	...do	++	Diarrhea	
26–28	425	204	11.9	38.9	...do	Present	...do	...do	...do	...do	Negative	...do	
30–31	540	204	11.8	38.2	...do	...do	...do	...do	...do	...do	+++	...do	
33–38	460	204	12.3	38.2	...do	...do	...do	...do	+	...do	+Slight	...do	
40–45	400	204	13.1	38.3	...do	Slight	Dark amber	...do	+	...do	...do	...do	
47–52	300	204	13.4	38.4	Slight cyanosis	...do	...do	...do	+	...do	...do	...do	
54–59	375	204	13.6	38.3	Pale	None	...do	...do	Negative	+	Negative	...do	
61–63	325	204	12.9	38.2	...do	Present	...do	...do	...do	+	...do	Hard	
66–71	375	204	13.4	38.2	...do	None	.....	.....	...do	+	+	Soft	
73–78	320	204	13	38.2	...do	...do	.....	.....	.....	None	Negative	Diarrhea	
80–85	340	204	13	38.4	...do	...do	.....	.....	.....	...do	+Slight	Soft	
87–92	.....	204	12.4	38.6	...do	Slight	.....	.....	.....	+	+	...do	Conjunctivæ slightly yellow.
94–99	.....	204	12.2	.....	Slight cyanosis	None	.....	.....	.....	None	Negative	...do	
101–106	.....	204	12.8	.....	...do	Slight	.....	.....	.....	...do	+Slight	Diarrhea	
108–113	.....	204	12.2	.....	...do	None	.....	.....	.....	...do	Negative	...do	
115–120	.....	204	13.1	.....	Pale	Slight	.....	.....	.....	+Slight	...do	Soft	Slight salivation. Very lively. Well nourished.

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[Diet changed to 350 grams of bread and 350 c. c. milk. T. N. T. discontinued.]

113–153	350 bread, 350 milk.	.....	13.8	.....	Pale.....	None.....	Light amber..	.....	.....	None....	.....	Soft or hard...	Well nourished.
154–168	.....do.....	.....	13.6	.....	.....do.....	...do.....	.....do.....	.....	.....	...do....	.....	.....do.....	
169–193	.....do.....	.....	14.1	.....	Pale pink.....	...do.....	Pale amber....	.....	.....	...do....	.....	.....do.....	Well-fed appearance.
194–217	.....do.....	.....	13.8	.....	.....do.....	...do.....	.....do.....	.....	.....	...do....	.....	Diarrhea occasionally.	
218–227	.....do.....	.....	14.1	.....	.....do.....	...do.....	.....do.....	.....	.....	...do....	.....	.....do.....	
228–259	.....do.....	.....	13.4	.....	.....do.....	...do.....	.....do.....	.....	.....	...do....	.....	Hard.....	
260–289	.....do.....	.....	11.5	.....	.....do.....	...do.....	.....do.....	.....	.....	...do....	.....	Soft.....	
290–295	.....do.....	.....	9.3	.....	.....do.....	...do.....	.....	.....	.....	...do....	.....	Hard.....	Mucous membranes of mouth intact. No symptoms except extensive mange.

[Changed to cooked fat beef diet.]

296–314	500 meat..	.....	9.5	.....	Pale pink.....	None.....	Pale amber....	.....	.....	None....	.....	Soft or hard...	Mucous membrane of mouth intact. No symptoms except extensive mange.
315–368	400 meat..	.....	10.9	.....	.....do.....	...do.....	.....do.....	.....	.....	.....	.....	Soft.....	Mange has disappeared.
369	.....	.....	10.1	.....	.....	.....	.....	.....	.....	.....	.....	.....	Killed with chloroform.

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TABLE 13—Continued.

DOG 4—Continued.

Day of experiment.	Hb.	Red cells per c. mm.	Reticulated reds.	White cells per c. mm.	Differential count.						Nucleated reds.	Character of reds.	Blood volume.		Plasma.				Clot.
					Small monos.	Large monos.	Pmn. n.	Pmn. eos.	Pmn. bas.	Tr.			Plasma.	Total.	Character.	Per cent.	Hemolysis.	Webster's reaction.	
	Per cent.				*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*			*c. c.*	*c. c.*					
1	108	7,120,000	.....	16,400	.....	.....	.....	.....	.....	.....	.....	.....	634	1,409	Clear.....	45	.....	.....	
6	103	6,192,000	.....	17,600	.....	.....	.....	.....	.....	.....	.....	Normal.....	589	1,091	Light brown, clear.	54	.....	.....	Firm.
13	98	5,136,000	.....	18,800	.....	.....	.....	.....	.....	.....	.....	.....do.....	568	979	.....do.....	58	.....	Negative.	Do.
21	93	5,392,000	.....	15,600	.....	.....	.....	.....	.....	.....	.....	Slight anisocytosis.	509	943	.....do.....	54	.....	.....do.....	Do.
27	90	5,240,000	12	17,600	7	3	84	2	.....	4	66	.....do.....	501	928	Clear.....	54	.....	.....do.....	Do.
36	73	4,552,000	13	17,000	9.5	13.5	65.5	1	.....	10.5	87	Normal.....	615	1,009	Amber, clear.....	61	None.	+Slight..	Do.
55	90	4,864,000	22	18,300	9.5	5.5	72	11	.....	2	19	Slight anisocytosis.	630	1,145	Light brown, clear.	55	..do..	Negative.	Do.
62	81	4,008,000	68	28,300	16	4	73	4	.....	3	390	.....do.....	524	873	Lipæmia	60	..do..	+++....	Do.
69	74	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Slight anisocytosis, basophilia.	.....	.....	.....	.....	.....	.....	.....
73	70	5,512,000	20	18,600	13	16	63	12	.....	6	58	.....	.....	.....	.....	.....	.....	.....	.....
80	64	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Slight anisocytosis, polychromatophilia.	574	956	Amber, clear.....	60	None.	++.....	Do.
85	68	6,480,000	102	26,400	9	4	76	10	.....	1	80	.....	.....	.....	.....	.....	.....	.....	.....
93	70	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Slight anisocytosis, polychromatophilia.	504	813	Light brown, clear.	62	None.	+.....	Do.
97	72	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
100	68	5,176,000	38	29,200	12	5	78	4	.....	1	24	.....	.....	.....	.....	.....	.....	.....	.....
107	57	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Anisocytosis, basophilia.	522	816	Light brown, clear.	64	None.	+.....	Do.
113	61	4,496,000	72	30,200	15	4	68	13	.....	.....	3	.....	.....	.....	.....	.....	.....	.....	.....
[illegible]	62	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Anisocytosis, basophilia.	579	905	Amber, clear.....	64	None.	++.....	Do.
[illegible]	64	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
[illegible]	65	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
[illegible]	74	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
[illegible]	73	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Water, clear.....	58	.....	Negative.	Do.
[illegible]	70	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
[illegible]	[illegible]	6,280,000	.....	19,800	7.5	5	83	5	.....	4	3	Anisocytosis.....	614	1,023	Water, clear.....	60	None.	Negative.	Do.
[illegible]	[illegible]	[illegible],782,000	.....	18,800	22.5	5	64.5	4	.5	3.5	0	Slight anisocytosis.	573	988	Amber, clear.....	58	None.	Negative.	Do.

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169	71	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
175	74	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
179	72	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
183	68	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
188	80	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
193	76	6,184,000	.....	16,000	35.5	5	49	2	5.5	3	0	Anisocytosis.....	662	1,085	Clear.....	61	.....	.....	
207	73	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....do.....	60	.....	.....	
217	69	4,784,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
227	79	5,544,000	.....	17,200	21.5	.5	72	.....	6	.....	2	Anisocytosis, poikilocytosis.	.....	.....	Pale amber, clear..	60	.....	.....	
240	64	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....do.....	59	.....	.....	
259	64	5,680,000	.....	26,400	9	2	84	1	1	3	0	Slight anisocytosis.	583	925	Amber, clear.....	63	.....	.....	
288	75	6,448,000	.....	17,200	13.5	.5	84.5	1	.5	.....	1	Anisocytosis.....	.....	.....	Pale amber, clear..	62	.....	.....	
295	72	5,984,000	.....	17,000	12	1	80	3	2	2	0	Slight anisocytosis.	656	1,058	.....do.....	62	.....	.....	
314	76	6,144,000	.....	16,200	9.5	2.5	83.5	3.5	.5	.5	0	Anisocytosis.....	558	885	.....do.....	63	.....	.....	
368	81	4,944,000	.....	13,600	7.5	1	87	4	.5	.....	1	.....do.....	528	960	.....do.....	55	None.	.....	Do.

May 5, 1919.—Autopsy.—Dog is fairly well nourished. Oral mucous membrane and conjunctivæ are intact. No icterus. Serous cavities are normal. Heart, lungs, stomach, intestines, pancreas, adrenals, and kidneys are normal in gross and in sections. Spleen is small and firm. The cut section shows no increased pigmentation. Microscopically the trabeculæ are concentrated. Pulp scanty. Malpighian bodies normal. No pigmented phagocytes. Mesenteric lymph glands are normal. Bone marrow of femur is mottled gray and pink. Microscopically it is chiefly fat, with many islands of active, myeloid tissue. Liver is pale and swollen. Gall bladder contains 16 c. c. of normal-looking bile. Bile ducts are normal. Microscopically the liver cells are swollen and contain many fat droplets. No scarring. No pigmented endothelial cells. Bile ducts are unchanged.

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TABLE 14.

[15 mg. T. N T. (No. 3 pure) per kilo, per os. Total amount T. N. T. given=3.76 grams.]

DOG 8.

[Meat diet.

Day of experiment.	Food eaten daily.	T.N.T. given.	Body weight.	Temperature (rectal).	Clinical symptoms.		Urine.					Feces.	Remarks.
					Character of mucous membranes.	Incoordination.	Color.	Albumin.	Fehling's test.	Bile pigment.	Webster's reaction.		
	Gms.	*Mg.*	*Kilos.*	*°C.*									
1	455	417	13.9	38.7	Normal	None	Reddish brown	None	Negative	None.	+		Old hound mongrel, bitch. Given, per os, T. N. T. No. 3 pure. 30 mg. per kilo body weight.
2	0			38.3	Marked cyanosis	Marked	do	do	do	do	+	Diarrhea	Refuses food.
3–8	225		13.0	38.1	Normal	do	do	do	do	do	Negative	do	
9	95	209		38	do	do	Dark amber	do	do	do	+?	+++	None.
10–11	300		12.3	38.2	do	do	Dark brown	do	do	None.	+	do	Given, per os, T. N. T. No. 3 pure. 15 mg. per kilo body weight.
12		209		38	Slight cyanosis	do	do	do	do	do	+ Slight	do	
14		209		37.8	Pale	do	do	do	do	do	++	Hard	
15–19	400	209	11.4	39	do	do	do	do	do	do	+	do	
21	492	209	11.5	38.1	do	Present	do	do	do	do	+++	Diarrhea	
26	675	209		38.6	do	Marked	do	do	do	do	+++	do	
28	100	209	10.8	38.6	do	do	do	do	+	do	+++	do	
29	190	209	10.5	39.1	Slight cyanosis	do	do	do	+	do	+++	do	
30	240	209	9.8	38.6	Pale	do	Amber	+	+	do	Negative	Soft	Very weak.
31	240	209		38.8	do	do	Dark amber			do	do	Diarrhea	
32	235	209		38.6	do	Present	Amber	Slight	Negative	do	do	do	
33	235	209	8.5	38.4	do	do	do	+	do	do	do	Soft	
34	240	209		38	do	Slight	do	+	+	do	do	Diarrhea	Weak and very thin.
35	95	209	7.6	38.1	do	do	do	+	Negative	do	do	do	
36	0	209		37.9	do	do	Pale amber			do		do	
			7.2				Amber	+	Negative	do	+ Slight	do	Scanty purulent discharge from nose. Conjunctivitis. Died.

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Day of experiment.	Hb.	Red cells per c. mm.	Reticulated reds.	White cells per c. mm.	Differential count.					Nucleated reds.	Character of reds.	Blood volume.		Plasma.				Clot.
					Small monos.	Large monos.	Pmn. n.	Pmn. eos.	Tr.			Plasma.	Total.	Character.	Per cent.	Hemolysis.	Webster's reaction.	
	Per ct.				Per ct.	Per ct.	Per ct.	Per ct.	Per ct.			c. c.	c. c.					
1	90	5,416,000	.....	12,800	.....	.....	.....	.....	.....	.....	Normal.....	741	1,425	Clear.....	52	None....	+Slight.	Firm.
3	94	5,080,000	.....	17,400	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	55	.....	.....	
8	80	4,624,000	.....	15,600	.....	.....	.....	.....	.....	.....	.....	663	1,163	Light brown, clear.	57	.....	.....	Do.
15	80	3,944,000	140	22,000	.....	.....	.....	.....	.....	.....	.....	541	832	Amber, clear.....	65	None....	++.....	Do.
22	46	3,120,000	113	43,600	2.5	7.5	84.5	.5	5	66	Anisocytosis.....	557	784	.....do.....	71	.....	+++...	Do.
29	54	3,232,000	110	26,200	2	7	77	.....	14	65	.....do.....	540	784	.....do.....	69	None....	+++...	Do.
36	55	3,512,000	11	32,000	3	4.5	88	.....	4.5	115	Slight anisocytosis.	508	747	Water, clear.....	68	...do....	+++...	Do.
44	56	2,928,000	111	117,500	2.5	5	87.5	.....	5	109	.....do.....	425	625	.....do.....	68	...do....	+.....	Do.
52	51	2,624,000	14	16,300	5	8.5	83	.....	3.5	11	.....do.....	400	555	Amber, clear.....	72	...do....	+..	Do.

June 28, 1918—Autopsy.—Dog is extremely emaciated. Skin is very loose. Subcutaneous fat has almost completely disappeared. Oral mucous membrane and conjunctivae are intact. No icterus. No excess of serous fluids. All parenchymatous organs are very pale and anemic looking. Heart and lungs are normal Stomach and intestines normal. Pancreas and adrenals are normal in gross and in sections. Kidneys are small and scarred. Capsule strips with difficulty leaving a very roughened cortex. On section the cortex is not appreciably narrowed, striae are irregular and the glomeruli stand out conspicuously. Microscopically the cortex contains many healed scars in which several glomeruli and their tubules have been obliterated. The surrounding glomeruli appear normal. The epithelial cells are swollen and granular. Many of the collecting tubules contain hyaline casts. Spleen is small and firm. On section the pulp is brownish-red, and very fibrous. The Malpighian bodies are inconspicuous. Microscopically the trabeculae are concentrated. Pulp is scanty and contains many megalocaryocytes and pigment-holding phagocytes. Bone marrow of femur is brownish-red and granular. Microscopically it shows an intense regenerative hyperplasia and contains a remarkable number of normoblasts, myelocytes and megalocaryocytes. There are a few hemosiderin-containing phagocytes. Liver pale and swollen. On cut section the lobulation is indistinct. Gall bladder is distended with 18 c.c. of very dark clear bile. Bile ducts are normal. Microscopically the liver cells are swollen and very granular. No scarring. The capillaries contain many endothelial Kupffer cells loaded with hemosiderin. Sciatic nerve (Marchi) shows a definite and fairly extensive degeneration of the myeline sheaths.

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TABLE 15.

[20 mg. T. N. T. (No. 7 pure) per kilo, subcutaneously. Total amount T. N. T. administered=12.6 grams.]

DOG 39.

[Meat and calcium phosphate. 20 gm. calcium phosphate per kilo meat.]

Day of experiment.	Food eaten.	T. N. T. given.	Body weight.	Temperature (rectal).	Clinical symptoms.		Urine.		Feces.	Remarks.
					Character of mucous membranes.	Incoordination.	Bile pigment.	Webster's reaction.		
	Gms.	*Mg.*	*Kilos.*	*° C.*						
1	.....	210	10.5	.....	.....	.....	.....	.....	.....	Young adult terrier mongrel, male. Active and normal. T. N. T. administered in 7 c. c. refined corn oil.
2	.....	210	.....	.....	Cyanosis	Present	++	++	.....	Salivation.
3	500	210	.....	.....	...do	Marked	.....	.....	Soft	
5–10	300	210	9.4	38.5	Slight cyanosis	Present	++	+Slight.	...do	Slight salivation.
12–17	200	210	8.8	38.3	.....do	Slight	++	.....	Diarrhea	
19–24	400	210	8.6	38.1	Normal	...do	+Slight.	+Slight.	Soft	
26–31	475	210	8.8	.....	.....do	...do	+	Negative	...do	Emaciated.
33–38	475	210	9.1	.....	Pale, slight icterus	Present	+	.....	...do	Droopy.
40–45	375	210	8.7	.....	Slight cyanosis	Marked	+++	.....	Diarrhea	Conjunctivitis, droopy.
47–52	250	210	8.7	.....	.....do	...do	+Slight.	.....	...do	Weaker.
54–59	225	210	8.4	.....	.....do	...do	+	Negative	...do	Conjunctivitis.
61–66	250	210	7.4	.....	.....do	...do	+	...do	...do	Do.
68	.....	210	.....	.....	Pale	...do	+Slight.	.....	.....	Do.
69	110	210	7.0	.....	Very pale, slight icterus	...do	.....	.....	Diarrhea	Conjunctivitis. Very weak.
70	80	210	6.8	.....	.....do	...do	+	.....	.....	Purulent conjunctivitis. Moribund. Died at 3.30 p. m.

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Day of experiment.	Hb.	Red cells per c. mm.	Reticulated reds.	White cells per c. mm.	Differential count.					Nucleated reds.	Character of reds.	Plasma.				Clot.
					Small monos.	Large monos.	Pmn. n.	Pmn. eos.	Tr.			Character.	Per cent.	Hemolysis.	Webster's reaction.	
	Per ct.				*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*							
1	120	6,240,000	0	18,400	15	.....	75	6	4	0	Normal.....	.....	50	None.....	Negative..	Firm.
5	102	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	48	.....	.....	.....
9	81	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Amber, clear.....	55	None.....	Negative..	Do.
17	57	4,496,000	38	22,000	13	.....	81	3	3	17	Anisocytosis, basophilia.	Light brown, clear.	68	...do.....	...do.....	Do.
20	57	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Amber, clear.....	66	...do.....	...do.....	Do.
24	69	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Light brown, clear.	58	...do.....	...do.....	Do.
30	69	7,040,000	33	19,000	2	14	82	2	.....	6	Anisocytosis, basophilia.	Lipaemia, amber..	61	...do.....	...do.....	Do.
34	73	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Light brown, clear.	61	...do.....	...do.....	Do.
38	53	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....do.....	68	...do.....	...do.....	Do.
44	43	3,664,000	56	30,400	5	.....	94	.....	1	31	Marked anisocytosis, basophilia.	.....do.....	74	...do.....	...do.....	Do.
50	55	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Amber, clear.....	66	.....	.....	.....
57	62	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Lipaemia ++.....	67	None.....	Negative..	Do.
68	63	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Amber, clear.....	64	...do.....	...do.....	Do.
70	60	3,680,000	.....	34,200	6	3	88	.....	3	0	Slight anisocytosis..	Yellow, clear.....	67	...do.....	...do.....	Do.

July 26, 1918.—Autopsy.—Conjunctivae are covered with a purulent exudate. Oral mucous membrane is intact except for a small superficial ulcer above the left canine tooth. There are three decubitus ulcers on the buttocks and one above the left hind paw. Subcutaneous fat is scanty and light yellow in color. Serous cavities are normal. All parenchymatous organs are pale and anaemic. Heart is normal. Aortic intima is lemon yellow in color. Lungs are normal. Pancreas and adrenals are normal. Stomach and duodenum contain bile-stained fluid. Mucosa is intact and normal. Kidneys are swollen and pale. Microscopically the parenchyma cells are swollen and granular. The lumina of many of the glomerular capsules are filled with coagulated fluid. Many of the collecting tubules contain hyaline casts. There are a few small groups of hemosiderin-holding phagocytes among the collecting tubules. Spleen is small and quite firm. On section the parenchyma is of a brownish red color. Microscopically the pulp contains a maximum number of large phagocytes loaded with heavy masses of coarsely granular dark brown hemosiderin. Some of the Malpighian bodies contain small hyaline masses. Mesenteric lymph glands normal. Microscopically there are no pigmented phagocytes. The sinuses contain a few wandering cells. Bone marrow of femur is deep brownish red and granular. Microscopically it is very hyperplastic. Few fat cells. Many fragmented nuclei. Numerous normoblasts. A great number of large phagocytic cells loaded with hemosiderin. Liver is swollen and pale. Capsule is thin. The cut section shows increased pigmentation. Gall bladder and bile ducts are normal. Microscopically the liver cells are swollen and granular. No scarring. Capillaries contain many large endothelial cells loaded with hemosiderin.

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TABLE 16.

[20 mg. T. N. T. (No. 6 crude) per kilo, per os. Total amount T. N. T. administered, 22.42 grams.]

DOG 35.

[Meat and calcium phosphate diet. 20 gm. calcium phosphate per kilo meat.]

Day of experiment.	Food eaten.	T. N. T. given.	Body weight.	Clinical symptoms.		Urine.			Feces.	Remarks.
				Character of mucous membranes.	Incoordination.	Color.	Bile pigment.	Webster's reaction.		
	Gms.	*Mg.*	*Kilos.*							
1	500	380	19	Normal	None		None	Negative	Soft	Adult bull terrier mongrel, male. Excellent condition.
3–5	390	380	17.7	do	Marked		+	do	do	Salivation.
6–8	295	380	17	do	do		None	do	do	Slight salivation.
10–15	180	380	15.9	Slight cyanosis	Slight		+ Slight	Negative	Diarrhea	Do.
17–22	287	380	14.6	Pale	Marked		None	do	do	
24–29	475	380	14	do	Slight		+ Slight	do	do	Do.
31–36	450	380	13.7	Slight cyanosis	Present		+	do	Soft	Do.
38–43	320	380	13.1	Pale	Marked		+ Slight		do	Droopy.
45–50	350	380	12.7	do	Slight		+	Negative	Diarrhea	Some mange.
52–57	300	380	11.9	Very pale	None	Dark brown	+	do	do	Extensive mange.
59–63	250	380	11.6	do	do	Brown	None	do	do	
65–66	190	380		Grayish white	do	Yellow	+	do	do	Droopy. Emaciated. Weak. Extentensive mange. Tongue pink.
67	170	380		Very pale	Present				do	Droopy. Very extensive mange. Tongue reddish brown and dry.
68	105	380	9.7	do	do	Brown	None	Negative	do	Very weak.
69		380	8.9			Brown (post mortem)		do		Moribund. Killed with chloroform.

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Day of experiment.	Hb.	Red cells per c. mm.	Reticulated reds.	White cells per c. mm.	Differential count.					Nucleated reds.	Character of reds.	Plasma.				Clot.
					Small monos.	Large monos.	Pmn. n.	Pmn. eos.	Tr.			Character.	Per cent.	Hemolysis.	Webster's reactions.	
	Per cent.				*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*							
1	99	10,472,000	3	16,200	21	4	66	3	6	0	Normal	Water, clear	50	None.	Negative.	Firm.
3	93												48			
8	67											Water, clear	60	None.	Negative.	Do.
14	71	5,832,000	40	27,800	4	2	92		2	15	Normal	Amber, clear	56	...do.	...do.	Do.
18	75											...do	58	...do.	...do.	Do.
22	79											Light-brown, clear	58	...do.	...do.	Do.
28	81	6,832,000	11	17,400	5	4	90		1	1	Slight basophilia	Amber, clear	55			
33	79											Light-brown, clear	54	None.	Negative.	Do.
36	64											...do	62	...do.	...do.	Do.
42	67	4,368,000	12	27,600	8	1	91			3	Anisocytosis	...do	62	...do.	...do.	Do.
48	63											Lemon-yellow, clear	62	...do.	...do.	Do.
55	59											Light-brown, clear	66	...do.	...do.	Do.
66	66											Lemon-yellow, clear	61			
68	60	4,072,000		39,800	1.5	1.5	86		11	2	Anisocytosis	...do	66	None.	Negative.	Do.

September 25, 1918.—Autopsy.—Extreme emaciation. Very extensive mange. Oral mucous membrane and conjunctivae are intact. No icterus. Subcutaneous and omental fats have almost completely disappeared. Serous cavities normal. Heart and lungs are normal. Stomach and intestines normal. Pancreas and adrenals are normal. Kidneys are normal except for a few small cortical infarcts. Spleen is small and firm. Microscopically the Malpighian bodies show areas of coagulation necrosis. Numerous pigmented cells in pulp mostly just outside the venules. Mesenteric lymph glands are normal. No pigmented cells. Bone marrow is hyperplastic. Liver is pale and slightly swollen. Microscopically some fat in cells about efferent veins. Cells swollen. No scarring. Few hemosiderin-containing phagocytes in capillaries.

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TABLE 17.

[20 mg. T. N. T. (No. 6 crude) per kilo, subcutaneously. Total amount T. N. T. given = 6.164 grams.]

DOG 19.

[Meat and calcium phosphate diet. 20 gm. calcium phosphate per kilo meat. Meat and calcium phosphate diet 9 days before beginning experiment.]

Day of experiment.	Food eaten daily.	T. N. T. given.	Body weight.	Temperature (rectal).	Clinical symptoms.		Urine.		Feces.	Remarks.
					Character of mucous membranes.	Incoordination.	Bile pigment.	Webster's reaction.		
	Gms.	*Mg.*	*Kilos.*	*° C.*						
1	.....	268	13.4	.....	Normal.....	None	None....	.....	.....	Young adult hound mongrel, male. T. N. T. administered in 8.93 c. c. refined corn oil.
2	.....	268	13.0	.....	Cyanosis.....	Present...	...do....	++.....	.....	
3	500	268	.....	.....	.....do.....	...do.....	.....	.....	Soft.....	
5–10	290	268	12.3	38.3	Slight cyanosis.....	Slight.....	+++...	+.....	Diarrhea..	Slight salivation.
12–17	155	268	11.2	38.1	.....do.....	...do.....	++.....	+Slight...	...do.....	Salivation.
19–24	167	268	10.2	38.1	Pale, slight cyanosis, slight icterus.....	...do.....	++.....	...do.....	...do.....	Good condition.
26	55	268	.....	.....	Definite icterus, very pale.....	None.....	++.....	+.....	...do.....	Dry exudate in nostrils. Appears rather sick.
27	0	268	9.2	.....	.....	.....	.....	.....	.....	Sick and weak. 11.45 p. m. found dead.

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Day of experiment.	Hb.	Red cells per c. mm.	Reticulated reds.	White cells per c. mm.	Differential count.					Nucleated reds.	Character of reds.	Plasma.				Clot.
					Small monos.	Large monos.	Pmn. n.	Pmn. eos.	Tr.			Character.	Per cent.	Hemolysis.	Webster's reaction.	
	P. ct.				*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*							
1	99	7,232,000	2	19,600	9	8	65	15	3	0	Normal	Lipaemia	52	None.	Negative.	Firm.
5	73												60			
10	63											Amber, clear	61	None.	Negative	Do.
16	62	8,328,000	24	62,000	4	1	94		1	138	Anisocytosis, basophilia.	Light brown, clear	60			
19	49											Amber, clear	69	None.	Negative	Do.
23	40											Light brown, clear	75	...do..	...do.....	Do.
27	29	2,800,000	74	83,200	2	1	96		1	77	Anisocytosis	Dark brown	81	...do..	...do.....	Do.

August 13, 1918.—Autopsy.—Dog is poorly nourished. Mucous membrane of mouth and conjunctivae are intact and definitely jaundiced. Subcutaneous and pericardial fats show a slight increased pigmentation. No reaction at sight of T. N. T. injections. Serous cavities normal. Aortic intima is pigmented lemon yellow. Heart is normal. Lungs are congested and oedematous at bases. Stomach and intestines normal. Pancreas, adrenals, and kidneys are normal in gross and in sections. Spleen is slightly enlarged. On section the parenchyma is brownish red, pulp scrapes with ease. Malpighian bodies are not conspicuous. Microscopically the pulp is heavily sprinkled with phagocytes loaded with hemosiderin. The venules and pulp are engorged. There are numerous normoblasts, myelocytes and megalocaryocytes. Mesenteric lymph glands are normal. Bone marrow of femur is mottled gray and brownish red and extends high into the shaft. Microscopically it is very hyperplastic and contains numerous pigment-holding phagocytes. The erythroblastic elements are very conspicuous. Liver is pale and fatty. On cut section the lobules are distinctly outlined by opaque yellowish gray centers and more translucent light brown peripheries. Gall bladder contains 8 c. c. of very dark thick bile. Bile ducts are apparently normal. Microscopically there is a great accumulation of fat in the liver cells about the central veins, leaving a narrow margin at the periphery of unchanged cells. The capillaries contain many normoblasts and large phagocytic cells loaded with hemosiderin. The periportal connective tissue is not increased. Sciatic nerve. is normal.

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TABLE 18.

[30 mg. T. N. T. (No. 3 pure) per kilo, per os. Total amount of T. N. T. given—23.1 grams.]

DOG 7.

[Meat diet followed by bread and milk.]

Day of experiment.	Food eaten daily.	T. N. T. given.	Body weight.	Temperature (rectal).	Clinical symptoms.		Urine.					Feces.	Remarks.
					Character of mucous membranes.	Incoordination.	Color.	Albumin.	Fehling's test.	Bile pigment.	Webster's reaction.		
	Gms.	*Mg.*	*Kilos.*	*°C.*									
1	500	266	8.8	.....	Normal	None	Amber	None	Negative	None	+	Soft	Young adult fox terrier, mongrel, male. Active and normal.
2-4	460	.....	9	38.7	do	Slight	do	do	do	do	+ Slight	do	
5-6	95	266	10	39	do	do	do	do	do	do	+	Diarrhea	
7	0	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Refuses food.
8-9	190	266	8.9	38.4	Normal	Slight	Amber	+ Slight	.....	+	+	Diarrhea	
11	415	266	.....	38.3	Pale	do	do	None	Negative	+ Slight	Negative	do	
13	175	266	.....	38.8	do	do	Light amber	do	do	do	+++	.....	
15	310	266	.....	38.6	do	Marked	Amber	do	do	do	++	Soft	
16-20	350	266	8.7	38.4	Slight cyanosis	Slight	Light amber	do	do	do	++	Diarrhea	
22-27	450	266	8.8	38.5	do	None	Amber	do	do	do	+	do	
29-34	350	266	8.6	38.3	do	Slight	do	.....	do	None	+	do	
36-41	350	266	8.6	38.5	Pale	None	do	None	do	do	+	Soft	
43-48	300	266	.....	38.3	do	do	do	do	do	do	Negative	Diarrhea	
55-55	300	266	8.7	38.2	do	do	Dark amber	do	do	do	+ Slight	do	In good condition.
57-59	380	266	8.3	38.1	do	do	Amber	do	do	do	do	do	
61-62	365	266	8.4	38.2	do	do	.....	.....	.....	+	Negative	do	
64-69	370	266	8.2	38.2	do	do	.....	.....	.....	+ Slight	do	do	
71-76	375	266	8.0	38.4	do	do	.....	.....	.....	+	do	Soft	
78-83	325	266	7.8	38.5	do	do	.....	.....	.....	+ Slight	do	do	Vomited part of food.
85-90	250	266	7.7	.....	Slight cyanosis	do	.....	.....	.....	+	+ Slight	Diarrhea	
92-97	250	266	7	.....	Pale	do	.....	.....	.....	+	Negative	do	Very weak and thin.
99-104	275	266	6.8	.....	Slight cyanosis	do	.....	.....	.....	+	.....	do	
106-108	225	266	6.6	.....	do	Slight	.....	.....	.....	+	.....	do	

[Diet changed to 250 grams bread and 250 cc. milk. T. N. T. discontinued.]

109	250 bread, 250 milk.	.....	6.5	.....	Very pale	None	.....	.....	.....	.....	.....	.....	Lively. Extremely emaciated.
110-195	do	.....	[1] 9.4	.....	do	do	.....	.....	.....	+ Slight	.....	Diarrhea	Some salivation.
197-199	None	.....	7.5	.....	Extensive ulceration of oral m. m.	.....	.....	.....	.....	do	.....	do	Refuses to eat. Profuse salivation.
200	do	.....	.....	.....	do	.....	.....	.....	.....	.....	.....	.....	1 p. m. found dead.

[1] Maximum.

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Day of experiment.	Hb.	Red cells per c. mm.	Reticulated reds.	White cells per c. mm.	Differential count.					Nucleated reds.	Character of reds.	Blood volume.		Plasma.				Clot.
					Small monos.	Large monos.	Pmn. n.	Pmn. eos.	Tr.			Plasma.	Total.	Character.	Per cent.	Hemolysis.	Webster's reaction.	
	Per cent.				*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*			*c. c.*	*c. c.*					
1	113	7,664,000	.....	9,800	.....	.....	.....	.....	.....	.....	.....	373	932	Clear.....	40	None....	Negative	Firm.
9	96	5,000,000	.....	10,600	.....	.....	.....	.....	.....	.....	.....	450	865	Light brown, clear.	52	Slight...	.....	
16	85	4,344,000	.....	12,200	.....	.....	.....	.....	.....	.....	Normal.....	452	729	.....do.....	62	None....	Negative	Do.
22	79	4,416,000	110	18,400	11	3	84	.....	2	4	.....do.....	435	725	Amber, clear..	60	...do....	+	Do.
31	77	4,688,000	37	23,400	8	3	79	.....	10	4	Slight anisocytosis basophilia.	400	678	.....do.....	59	...do....	+	Do.
51	95	5,188,000	38	21,950	6	5	84.5	1.5	3	0	Slight anisocytosis.....	434	775	.....do.....	56	...do....	Negative	Do.
57	91	3,676,000	44	22,800	10	4	82	1	3	3	.....do.....	390	663	Water, clear ..	59	...do....	...do....	Do.
64	71	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
68	72	4,312,000	12	12,700	13	2	81	.....	4	41	Anisocytosis.....	373	601	Amber, clear..	62	None....	+ Slight.	Do.
75	81	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
80	75	5,872,000	82	13,600	12	1	85	1	1	16	Slight anisocytosis.....	358	587	Light brown, clear.	61	None....	+ Slight.	Do.
88	76	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
90	70	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
95	70	4,320,000	53	18,200	7	3	88	2	.....	2	Slight anisocytosis.....	298	451	Light brown, clear.	66	None....	Negative	Do.
99	69	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
102	67	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
104	69	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
106	79	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
108	75	5,864,000	72	11,000	13	4	80	2	1	1	Slight anisocytosis.....	298	505	Amber, clear..	59	None....	+	Do.
114	65	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
118	75	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
124	78	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Light brown, clear.	57	None....	Negative	Do.
129	85	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
141	92	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
146	80	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
150	83	6,040,000	.....	16,400	14.5	7.5	71	1.5	5.5	0	Normal.....	405	698	Amber, clear..	58	None....	Negative	Do.
157	81	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
163	82	5,456,000	.....	16,200	20.5	4.5	71.5	1.5	2	0	Normal.....	430	705	Amber, clear..	61	None....	Negative	Do.
170	77	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
174	75	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
178	72	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
183	78	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
188	73	5,760,000	.....	14,600	11	3	85	.5	.5	0	Anisocytosis.....	514	816	Clear.....	63	.....	.....	.....
199	78	5,384,000	.....	..6,400	13	13	74	.....	.....	4	.....do.....	405	686	.....do.....	59	.....	.....	.....

October 21, 1918.—Autopsy.—Dog is fairly well nourished. Extensive superficial ulceration of oral mucous membrane. Mucous membrane comes away in long shreds. Conjunctivae are intact. Heart and lungs are normal. Stomach and intestines negative. Spleen is small and fibrous and shows no increased pigmentation. Microscopically the trabeculae are concentrated. Malpighian bodies small. Pulp contains a great many megalocaryocytes. No pigmented phagocytes. Liver pale and slightly enlarged. Microscopically the liver cells are swollen and granular. No scarring. The endothelial Kupffer cells are inconspicuous. Bile structures are unchanged. Bone marrow is mottled gray and red. Microscopically it is hyperplastic. Considerable fat. Very vascular. No pigment-holding phagocytes.

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TABLE 19.

33 mg. T. N. T. (No. 2 crude) per kilo, per os. Total amount T. N. T. given, 33.7 grams.]

DOG 9.

Meat diet.]

Day of experiment.	Food eaten daily.	T.N.T. given.	Body weight.	Temperature (rectal).	Clinical symptoms.		Urine.					Feces.	Remarks.
					Character of mucous membranes.	Incoordination.	Color.	Albumin.	Fehling's test.	Bile pigment.	Webster's reaction.		
	Gms.	*Mg.*	*Kilos.*	*°C.*									
1	405	1,089	16.5	.....	Normal.....	None.....	Pale yellow...	None.....	Negative..	None.....	+++.....	Hard.....	Adult bull mongrel, bitch. Given, per os, T. N. T. No. 3 pure 66 mg. per kilo body weight.
2	400	.....	.....	38.7	Cyanosis.....	Present...	Reddish brown.	...do.....	...do.....	...do.....	++.....	None.....	
3	410	.....	16.8	38.3	.....do.....	...do.....	.....do.....	...do.....	...do.....	...do.....	+Slight...	...do.....	
4–5	207	.....	.....	37.7	Normal.....	None.....	Dark amber...	...do.....	...do.....	+Slight....	Negative..	...do.....	
6	410	1,089	.....	38.2	.....do.....	...do.....	.....do.....	+Slight...	.....	None.....	++++...	...do.....	Given, per os, T. N. T. No. 3 pure 66 mg. per kilo body weight.
7	90	500	.....	38.5	.....do.....	Slight.....	Very dark brown.	.....	.....	...do.....	++.....	Hard.....	Given, per os, T. N. T. No. 2 crude 33 mg. per kilo body weight.
8–9	247	.....	16.1	38.6	.....do.....	Marked...	Dark brown...	None.....	Negative..	+Slight...	+.....	Diarrhea..	
10	320	500	.....	38.3	Pale pink.....	...do.....	.....do.....	...do.....	...do.....	None.....	Negative..	...do.....	
13–14	170	500	15.5	38.7	Slight cyanosis.....	...do.....	.....do.....	...do.....	...do.....	...do.....	+++.....	Soft.....	
17	90	500	15.1	38	Pale pink.....	...do.....	.....do.....	...do.....	...do.....	...do.....	Negative..	None.....	
20	370	500	.....	38.3	.....do.....	...do.....	Reddish brown.	...do.....	...do.....	+	++.....	Diarrhea..	
22	572	500	14.6	38.5	.....do.....	...do.....	.....do.....	...do.....	...do.....	None.....	Negative..	...do.....	
24–25	346	500	.....	38.6	.....do.....	Present...	.....do.....	...do.....	+	...do.....	+++.....	...do.....	No skin lesions.
27–32	290	500	14.1	38.5	.....do.....	...do.....	.....do.....	...do.....	+	+Slight...	+.....	...do.....	
34–39	270	500	12.7	38.4	.....do.....	...do.....	Dark brown...	+Slight...	+	++.....	++.....	...do.....	
41–46	288	500	12.7	38.4	.....do.....	...do.....	Dark amber...	Trace.....	Negative..	None.....	Negative..	...do.....	
48–53	310	500	12.5	38.4	.....do.....	Slight.....	.....do.....	None.....	...do.....	...do.....	...do.....	...do.....	
55–57	385	500	12.1	38.2	.....do.....	...do.....	.....do.....	...do.....	...do.....	...do.....	...do.....	...do.....	
59–60	350	500	12.3	38.1	.....do.....	...do.....	.....	.....	...do.....	...do.....	+Slight...	...do.....	
62–67	380	500	11.7	38.1	.....do.....	...do.....	.....	.....	.....	...do.....	++.....	...do.....	
69–74	280	500	11.2	38.4	.....do.....	...do.....	.....	.....	.....	...do.....	Negative..	Soft.....	
76–81	295	500	10.3	38.7	.....do.....	Present...	.....	.....	.....	+	+Slight...	Diarrhea..	Extreme emaciation.
83–88	50	500	9.2	.....	.....do.....	Marked...	.....	.....	.....	+	...do.....	...do.....	
90	0	500	.....	.....	.....do.....	...do.....	.....	.....	.....	+	Negative..	None.....	Mucous membranes intact.
91	.....	.....	8.5	.....	.....do.....	.....	.....	.....	.....	.....	.....	.....	9 a. m. found dead.

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Day of experiment.	Hb.	Red cells per c. mm.	Reticulated reds.	White cells per c. mm.	Differential count.					Nucleated reds.	Character of reds.	Blood volume.		Plasma.				Clot.
					Small monos.	Large monos.	Pmn. n.	Pmn. eos.	Tr.			Plasma.	Total.	Character.	Per cent.	Hemolysis.	Webster's reaction.	
	Per ct.				*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*			c. c.	c. c.					
1	96	7,152,000	.....	14,200	.....	.....	.....	.....	.....	.....	.....	759	1,607	Slight lipaemia...	47	None	.....	Firm.
3	84	6,288,000	.....	11,200	.....	.....	.....	.....	.....	.....	.....	.....	.....	Light brown.....	54	..do..	+Slight.	Do.
8	66	3,896,000	.....	20,600	.....	.....	.....	.....	.....	.....	.....	859	1,282	.....do.....	67	..do..	+.....	Do.
16	70	4,032,000	.....	41,000	.....	.....	.....	.....	.....	.....	.....	738	1,153	Amber, clear.....	64	..do..	+.....	Do.
22	59	4,168,000	2	15,200	8	16	70	1	5	17	Slight anisocytosis.	704	1,083	.....do.....	65	..do..	+.....	Do.
28	64	4,136,000	74	34,400	17	6.5	68	.....	8.5	278	.....do.....	657	1,026	.....do.....	64	..do..	++...	Do.
35	65	5,104,000	24	25,000	9.5	13	69	.....	8.5	74	.....do.....	556	882	Lemon yellow....	63	..do..	++.....	Do.
43	76	4,696,000	50	15,200	19.5	8	64	.....	8.5	397	Anisocytosis, basophilia.	635	1,024	Light brown.....	62	..do..	++.....	Do.
52	75	4,720,000	42	26,700	17	8	74	.....	1	262	.....do.....	625	1,115	Amber, clear.....	56	..do..	+.....	Do.
62	60	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
66	60	3,744,000	41	26,200	16	7	74	.....	3	195	Anisocytosis, basophilia.	618	909	Amber, clear.....	68	None.	+.....	Do.
72	59	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
78	64	4,064,000	20	22,800	9	1	83	4	3	64	Anisocytosis, basophilia.	497	802	Dark brown.....	62	None.	++.....	Do.
83	52	3,720,000	60	33,800	8	1	89	.....	2	29	.....do.....	457	672	.....do.....	68	..do..	++.....	Do.
85	49	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
88	47	3,594,000	25	31,600	1.5	1.5	96	.....	1	1	Anisocytosis, basophilia.	405	578	Dark brown.....	70	None.	++.....	Do.
90	42	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

October 6, 1918—Autopsy.—Dog is extremely emaciated. Conjunctivae are slightly jaundiced. Oral mucous membranes are intact. Serous fluids are not increased. All parenchymatous organs are pale and anaemic. Heart is normal in gross and in sections. Lungs show a few small areas of bronchopneumonia. Stomach and intestines are apparently normal. Pancreas and adrenals are normal. Kidneys are swollen. Capsule strips easily. The cortex contains many abscesses varying from 1 mm. to 0.5 cm. in diameter. The larger ones are filled with a greenish-yellow pus. On section, the surrounding tubules are grayish red and swollen. Microscopically, many of the abscesses are linear. The tubules are necrotic and are surrounded by a purulent exudate. Spleen is not enlarged. On section the parenchyma is deep reddish brown in color. Malpighian bodies are inconspicuous. Microscopically, the pulp is very heavily stippled with hemosiderin-holding phagocytes. Some of the Malpighian bodies show areas of coagulation necrosis. Mesenteric lymph glands are normal in gross. Microscopically, the sinuses contain a few phagocytes holding a yellowish-brown iron-reacting pigment. Bone marrow of femur is granular and deep brownish red in color. Microscopically, it is very cellular, quite vascular, and contains only a few fat cells. There are numerous phagocytes heavily loaded with hemosiderin. Liver is slightly enlarged. Capsule is thin. On section, the lobules are sharply outlined by opaque yellowish-brown centers and more translucent reddish-brown peripheries. The gall bladder contains 36 c. c. very dark clear bile. The bile ducts are normal. Microscopically, there is a very extensive central fatty change involving four-fifths of all the liver cells. The liver cells surrounding the portal areas are swollen and contain a few fat droplets. No scarring. Capillaries contain many endothelial Kupffer cells heavily loaded with a coarsely-granular iron-containing pigment.

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TABLE 20.

[5 mg. T. N. T. (No. 4 crude) per kilo, per os. Total amount T. N. T. administered=1.28 grams.

DOG 32.

[Bread and milk diet 2 days before beginning experiment.]

Day of experiment.	Food eaten daily (gms.).	T. N. T. given.	Body weight.	Clinical symptoms.		Urine.		Feces.	Remarks.
				Character of mucous membrane.	Incoordination.	Bile pigment.	Webster's reaction.		
		Mg.	*Kilos.*						
1	225 bread, 225 milk	80	15.8	Normal	None	None		None	Young adult bull mongrel, male. Active and normal.
2	300 bread, 300 milk	80		do	Slight	do		Diarrhea	Excellent condition.
3–4	150 bread, 150 milk	80	15	do	Marked	+		Soft	
6–11	175 bread, 175 milk	80	13.5	Pale pink	Present	+++	Negative	do	
13–17	200 bread, 200 milk	80	12.8	do	do	+Slight	do	do	Very active.
18	150 bread, 150 milk	80	12.8	do	None	+	do	do	Vocal cords cut under ether anaesthesia.
19	None								Gas bacillus infection involving head and neck.
20									9 a. m. found dead.

Day of experiment.	Hb.	Red cells, per c. mm.	Reticulated reds.	White cells, per c. mm.	Differential count.					Nucleated reds.	Character of reds.	Blood volume.		Plasma.				Clot.
					Small monos.	Large monos.	Pmn. n.	Pmn. eos.	Tr.			Plasma.	Total.	Character.	Per cent.	Hemolysis.	Webster's reaction.	
	Per ct.				*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*			*c. c.*	*c. c.*					
1	94	4,548,000	2	7,800	10	5	82	2	1	0	Normal	756	1,374	Amber, clear	55	None	Negative	Firm.
6	83																	
10	68																	
14	56	5,284,000	90	16,200	8	1	90	0	1	2	Marked anisocytosis, polychromatophilia.	609	858	Light brown, clear	71	None	Negative	Do.
18	53																	

July 29, 1918—Autopsy.—Animal is twice its normal size, mucous membrane of mouth is intact and very pale. No icterus. Subcutaneous tissues and parenchymatous organs containing a maximum number of gas bubbles. Serous cavities are normal. Heart and lungs normal. Stomach and intestines are greatly distended with gas. Very marked post mortem degeneration of all parenchymatous organs. Bone marrow of femur is uniformly deep red and granular.

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TABLE 21.

[5 mg. T. N. T. (No. 5 pure) per kilo, per os. Total amount T. N. T. administered=1.04 grams.]

DOG 47.

[Bread and milk diet 8 days before beginning experiment.]

Day of experiment.	Food eaten daily (gms.).	T. N. T. given.	Body weight.	Clinical symptoms.		Urine.		Feces.	Remarks.
				Character of mucous membranes.	Incoordination.	Bile pigment.	Webster's reaction.		
		Mg.	*Kilos.*						
1	300 bread, 300 milk	81	16.2	Normal	None	+Slight		Diarrhea	Adult tan cur, male. Excellent condition.
2	150 bread, 150 milk	81		do	Marked			Soft	Slight salivation.
4- 9	175 bread, 175 milk	81	14.1	Pale	do	++	Negative	Diarrhea	Do.
11-13	50 bread, 50 milk	81	12.8	do	Present	+	do	do	Marked salivation. Foul breath.
14	None	81		Pale, ulcerated	Marked			do	Superficial ulceration of mucous membrane of lips, gums, and under surface of tongue. Extreme salivation. Very foul breath.
15	do	81	11.1	do	Present	+	Negative	None	
16			10.8						Died at 3 a. m.

Day of experiment.	Hb.	Red cells, per c. mm.	Reticulated reds.	White cells, per c. mm.	Differential count.					Nucleated reds.	Character of reds.	Blood volume.		Plasma.				Clot.
					Small monos.	Large monos.	Pmn. n.	Pmn. eos.	Tr.			Plasma.	Total.	Character.	Per cent.	Hemolysis.	Webster's reaction.	
	Per ct.				*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*			*c. c.*	*c. c.*					
1	86	8,432,000	1	10,600	19	2	55	22	2	0	Normal	762	1,465	Water, clear	52	None	Negative	Firm.
4	79																	
9	59																	
12	58	6,120,000	3	6,200	22.5	7.5	60.5	2.5	7	0	Slight anisocytosis	692	1,033	Amber, clear	67	None	Negative	Do.
14	61																	

August 3, 1918—Autopsy.—Mucous membrane of mouth and under surface of tongue are covered with superficial ulcers. The mucous membrane comes away in long shreds The conjunctivae are intact and normal in color. Subcutaneous and omental fats are normal in color. No icterus. Heart shows a thrombus originating back of the tricuspid valve, extending up through the pulmonary artery and completely occluding the branch leading to the middle lobe of right lung. The middle lobe of right lung is beefy and uniformly purplish-red in color. The cut section is juicy and of a purplish red color. Microscopically the framework of the lung is intact, many of the epithelial cells lining the alveoli have disintegrated; the alveoli and bronchi are filled with serous fluid, red corpuscles, and numerous phagocytes containing a light brown pigment. The small branches of the pulmonary artery are occluded by nonorganized thrombi. The upper and lower lobes of the right lung and the left lung are normal except for a few small areas of broncho-pneumonia. Stomach and intestines are normal. Pancreas, adrenals, and kidneys normal. Spleen is small and firm. The cut section appears normal except for slight increased pigmentation. Microscopically the venules and pulp are not congested. The Malpighian bodies are normal. The pulp contains numerous phagocytes loaded with coarsely granular hemosiderin. Mesenteric lymph glands normal. Bone marrow is deep red and granular and extends high into shaft of fenur. Liver is normal in size. Capsule is thin. On cut section the lobulation is regular. The centers of the lobules are very red, the peripheries are pale. The connective tissue stroma is not increased. Gall bladder is normal, contains 7 c. c. of very dark thick bile. The gall ducts are normal. Microscopically the capillaries about the efferent veins are distended. The liver cells are quite normal. No scarring. The Kupffer cells stand out conspicuously and contain hemosiderin.

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TABLE 22.

[15 mg. T. N. T. (No. 5 pure) per kilo, per os. Total amount T. N. T. administered=2.11 grams.]

DOG 25.

[Bread and milk diet. Bread and milk diet 6 days before beginning experiment.]

Day of experiment.	Food eaten daily. (gms.).	T. N. T. given.	Body weight.	Clinical symptoms.		Urine.			Feces.	Remarks.
				Character of mucous membranes.	Incoordination.	Fehling's test.	Bile pigment.	Webster's reaction.		
		Mg.	*Kilos.*							
1	300 bread, 300 milk	234	15.3	Normal	None		None		Diarrhea	Young adult hound, bitch. Very active.
2	100 bread, 100 milk	234		Slight cyanosis	Marked			+Slight	do	
5–6	75 bread, 75 milk	234	14	do	do	Negative	None	do	do	
8–9	100 bread, 100 milk	234	13.8	Very pale	do	do	+	do	None	
11	75 bread, 75 milk	234	13.3	do	do				do	
13–14	40 bread, 40 milk	234		do	do		None	+Slight	Diarrhea	Sick and weak.
15			12.7							9 a. m. found dead.

Day of experiment.	Hb.	Red cells per c. mm.	Reticulated reds.	White cells per c. mm.	Differential count.				Nucleated reds.	Character of reds.	Blood volume.		Plasma.				Clot.
					Small monos.	Large monos.	Pmn. n.	Tr.			Plasma.	Total.	Character.	Per cent.	Hemolysis.	Webster's reaction.	
	P. ct.				*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*			*c. c.*	*c. c.*					
1	129	6,932,000	1	9,750	16	10	72	2	0	Normal	686	1,345	Water, clear	51	None.	Negative	Firm.
5	90																
11	28																
12	29	1,360,000	0	26,700	4.5	4	83	8.5	70	Anisocytósis, poikilocytosis, polychromatophilia.	665	773	Amber, clear	86	None.	+Slight.	Do.

July 12, 1918—Autopsy.—Oral mucous membrane and conjunctivae are intact. No jaundice. Subcutaneous and omental fats are quite abundant and normal in color. Serous cavities are normal. Heart and lungs are normal. Stomach and intestines normal. Pancreas, adrenals, and kidneys are normal in gross and in sections. Spleen is slightly enlarged. The cut section is brownish red in color; the Malpighian bodies are quite distinct. Microscopically many of the Malpighian bodies are infiltrated with hyaline masses, others are almost completely obliterated. The pulp contains a great many nucleated red cells, many megalocaryocytes, myelocytes, some of which are in the state of mitosis, and numerous pigment-holding phagocytes. Mesenteric lymph glands are normal in gross. Microscopically the sinuses and lymph cords contain many phagocytes loaded with hemosiderin. Bone marrow of femur is deep red and granular. Microscopically it is hyperplastic and contains a great many phagocytes loaded with coarsely granular hemosiderin. The liver is somewhat enlarged, very pale, and fatty looking. On section the lobules are distinctly outlined with opaque yellowish centers and more translucent peripheries. The gall bladder contains 25 c. c. of dark brown thick bile. The bile ducts are normal. Microscopically the liver cells about the efferent veins are abundantly loaded with large and small fat droplets. The liver cells about the portal areas are more normal, although many of them contain fat droplets. There are a few focal areas of necrosis indicated chiefly by accumulations of polyblasts. The intralobular capillaries contain many nucleated red cells and endothelial cells loaded with hemosiderin. No scarring. The bile ducts are normal. Sciatic nerve is normal. The myeline sheaths are only faintly stained with osmic acid. (Marchi.)

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TABLE 23.

[30 mg. T. N. T. (No. 4 crude) per kilo, per os. Total amount T. N. T. administered=4.24 grams.]

DOG 20.

[Bread and milk diet. Bread and milk diet 6 days before beginning experiment.]

Day of experiment.	Food eaten daily (gms.).	T. N. T. given.	Body weight.	Clinical symptoms.		Urine.		Feces.	Remarks.
				Character of mucous membranes.	Incoordination.	Bile pigment.	Webster's reaction.		
		Mg.	*Kilos.*						
1–2	150 bread, 150 milk	471	15.7	Normal	None	None			Adult bull mongrel, bitch. Very active.
4	75 bread, 75 milk			Slight cyanosis	Marked	do			
5–6	85 bread, 85 milk	471	14.3	do	do	do	+Slight	Diarrhea	
8–9	125 bread, 125 milk	471	14.4	Normal	Present	do	do	do	
11	100 bread, 100 milk	471		do	do			do	Slight salivation.
13–14	75 bread, 75 milk	471	13.3	Mucous membrane of mouth ulcerated.	do	None	Negative	do	Superficial ulceration of oral mucous membrane.
15	do		12.6	do	Marked	do		do	Extreme salivation. Very foul breath.
16	None		11.4	do	do	+Slight	Negative		Moribund. Killed with ether.

Day of experiment.	Hb.	Red cells per c. mm.	Reticulated reds.	White cells per c. mm.	Differential count.					Nucleated reds.	Character of reds.	Blood volume.		Plasma.				Clot.
					Small monos.	Large monos.	Pmn. n.	Pmn. eos.	Tr.			Plasma.	Total.	Character.	Per cent.	Hemolysis.	Webster's reaction.	
	P. ct.				*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*			*c. c.*	*c. c.*					
1	115	6,312,000	1	16,100	21	4	73		2	0	Normal	722	1,388	Water, clear	52	None	Negative	Firm.
5	106																	
11	75																	
12	72	3,488,000	22	17,700	21	1.5	70		7.5	0	Slight anisocytosis	532	858	Amber, clear	62	None	+Slight.	Do.
14	55			13,070														
16	45	2,600,000	125	12,600	23	1	70	3	3	0	Anisocytosis, poikilocytosis, polychromatophilia.	608	789	Amber, clear	77	None	+++	Do.

July 13, 1918.—Animal is moribund. The mucous membrane of the mouth and undersurface of the tongue is covered with superficial ulcerations. The mucous membrane comes away in shreds. The mucous membrane and subcutaneous tissue opposite the molar teeth is gangrenous and dirty gray in color. The breath is extremely foul. Pulse 152 Respiration 16. No icterus. 11.45 a. m. anaesthetized with ether and bled to death.

Autopsy.—The subcutaneous and omental fats are normal in color. No excess of serous fluids. Heart and lungs normal. Stomach and intestines collapsed. Mucosa of small intestine is covered with a heavily bile-stained mucous. Mucosa is intact and normal. Pancreas, adrenals, and kidneys are normal. Spleen is small and firm. The cut section is brownish red in appearance. The Malpighian bodies stand out plainly. Microscopically the pulp contains a maximum number of pigment-holding phagocytes. Mesenteric lymph glands are normal. Bone marrow is mottled gray and pink. Microscopically it is mostly fat although there are numerous areas showing cellular activity. Liver is extremely pale and shows some increased pigmentation. The gall bladder is normal and contains 25 c. c. very dark concentrated bile. The gall ducts are normal. Microscopically the liver cells are normal. The Kupffer cells are loaded with hemosiderin. The bile ducts are normal. Sciatic nerve is degenerated. Many of the medullary sheaths are reduced to fat-like globules which stain black with osmic acid. (Marchi.)

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TABLE 24.

[33 mg. T. N. T. (No. 4 crude) per kilo, per os. Total amount T. N. T. administered= 10.37 grams.]

DOG 33.

[Bread and milk diet. Bread and milk diet three days before beginning experiment.]

Day of experiment.	Food eaten daily (grams).	T. N. T. given.	Body weight.	Clinical symptoms.		Urine.		Feces.	Remarks.
				Character of mucous membranes.	Incoordination.	Bile pigment.	Webster's reaction.		
		Mg.	*Kilos.*						
1	200 bread, 200 milk	610	18.5	Normal	None	None	Negative	Diarrhea	Young adult Airedale mongrel, bitch. Active and normal.
2- 3	100 bread, 100 milk	610	17.7	Slight cyanosis	Marked	do	+Slight	do	
5- 6	do	610	17	Normal	Present	do	Negative	do	
9-13	200 bread, 200 milk	610	15.9	Pale	Slight	do	do	do	
15-20	220 bread, 220 milk	610	14.6	do	Present	do	+Slight	Soft	
22	None	610		do	Marked	do		do	Marked salivation. Oral mucous membrane intact.
23-24	do		13.1	do	do	do	Negative	do	Very marked salivation. Foul breath.
25	do		12.5	do	do	do	do		Moribund. Killed with ether.

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Day of experiment.	Hb.	Red cells per c. mm.	Reticulated reds.	White cells per c. mm.	Differential count.					Nucleated reds.	Character of reds.	Blood volume.		Plasma.				Clot.
					Small monos.	Large monos.	Pmn. n.	Pmn. eos.	Tr.			Plasma.	Total.	Character.	Per cent.	Hemolysis.	Webster's reaction.	
	P. ct.				*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*			c. c.	c. c.					
1	111	6,060,000	5	14,500	12	7	71	.....	10	0	Normal.....	771	1,512	Water, clear.....	51	None	Negative	Firm.
2	86	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
8	62	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
9	61	3,936,000	104	14,100	8	9	77.5	2	3.5	45	Poikilocytosis, basophilia.	749	1,118	Amber, clear.....	67	None	Negative	Do.
15	63	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
19	67	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
23	82	7,648,000	1	15,600	4	1	94	1	.....	4	Anisocytosis, basophilia.	576	1,028	Amber, lipaemia...	56	None	Negative	Do.
25	79	8,480,000	None	18,200	5	3	89	3	.....	0	Marked anisocytosis...	510	911	Light brown, clear.	56	None	++	Do.

July 25, 1918.—Animal is moribund. Killed with ether.

Autopsy.—Mucous membrane of mouth is intact. Conjunctivae are normal. No icterus. Subcutaneous and omental fats are normal in color. Serous cavities normal. Heart and lungs normal. Pancreas, adrenals, and kidneys are normal. Stomach and intestines normal. Spleen is small and soft. The cut section is juicy and purplish red in color. Microscopically rather rarefied and spongy. Splenic pulp contains many megalocaryocytes. Also many phagocytic cells loaded with hemosiderin. Mesenteric lymph glands are normal in gross. Microscopically, there are a few pigment-holding phagocytes. Bone marrow of femur is of a uniform deep red color. Microscopically it is very cellular and contains many phagocytes which hold a coarsely granular iron-reacting yellowish brown pigment. Liver is swollen and pale. Gall bladder contains 30 c. c. of very dark concentrated bile. The gall ducts are normal. Microscopically the liver cells are greatly swollen. The capillaries are almost closed. There are some focal accumulations of cells. No scarring. Hemosiderin-containing endothelial cells are abundant and are distinctly continuous with other endothelial cells lining the capillaries. Sciatic nerve shows a typical, though not extensive, degeneration of the myeline sheaths (Marchi.).

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TABLE 25.

[5 mg. T. N. T. (No. 7 pure) per kilo, subcutaneously. **Total amount T. N. T. given=15.37 grams.**]

DOG 28.

[Bread and milk diet followed by meat and calcium phosphate. Bread and milk diet 6 days before beginning experiment.]

Day of experiment.	Food eaten daily (grams).	T. N. T. given.	Body weight.	Clinical symptoms.		Urine.		Feces.	Remarks.
				Character of mucous membranes.	Incoordination.	Color.	Bile pigment.		
		Mg.	*Kilos.*						
1	400 bread, 400 milk	85.4	16.9	Normal	None		None		Adult setter, bitch. Active and normal.
2	225 bread, 225 milk	85.4		do	do		do	Soft	T. N. T. administered in 2.85 c. c. refined corn oil, Mazola.
4–9	300 bread, 300 milk	85.4	15.4	Slight cyanosis	Slight		do	do	Slight salivation.
11–16	90 bread, 90 milk	85.4	14.3	do	do		do	Diarrhea	
18–23	60 bread, 60 milk	85.4	13.1	do	do		do	do	
25–30	250 bread, 250 milk	85.4	12.2	Normal	do		do	do	Droopy and weak.
32–37	300 bread, 300 milk	85.4	12.1	do	do		do	do	Droopy. Emaciated.
39–44	do	85.4	12.5	do	None		+	Soft	
46–51	do	85.4	11.8	Pale pink, slight cyanosis	do		None	Diarrhea	
53–58	do	85.4	11.7	do	Slight	Light brown	do	do	Slight salivation.
60–65	do	85.4	11.6	do	do	Dark brown	do	do	
67–72	do	85.4	11.5	Very pale pink	do	Brown	do	do	Salivation.
74–79	400 bread, 400 milk	85.4	11.9	Pale pink	None	do	+ Slight	do	Do.
81–86	425 bread, 425 milk	85.4	11.6	do	do	do	do	do	
88–93	do	85.4	12.2	do	do	Light brown	do	do	
95–100	450 bread, 450 milk	85.4	11.7	do	do	Brown	do	do	Weak and thin.
102–107	375 bread, 375 milk	85.4	11.7	do	do	do	do	do	
109–114	400 bread, 400 milk	85.4	12.2	do	do	Light brown	None	do	
117–121	do	85.4	11.4	Very pale pink	do	do	do	do	
123–124	do	85.4	11.7	do	do	do	+ Slight	do	

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[Diet changed to cooked fat beef containing 20 grams calcium phosphate per kilo.]

125–128	500	85.4	12.2	Very pale pink	None	Light brown	None	Soft	
130–135	500	85.4	13.2	do	do	do	do	do	
137–139	495	85.4	13	do	do	do	do	Diarrhea	
141–142	485	85.4	12.8	do	do	Yellow	do	do	
144–149	480	85.4	13.2	Pale pink	Slight	Light brown	do	do	Extensive mange.
151–156	495	85.4	13.5	do	None	Brown	+ Slight	Soft	
158–163	490	85.4	13.3	do	do	do	do	Hard	
165–170	495	85.4	13	do	do	do	do	Diarrhea	Do.
172–177	490	85.4	13.3	do	do	Dark brown	do	do	
179–184	480	85.4	11.9	do	do	do	+	do	
186–191	480	85.4	12.1	do	do	Light brown	None	Soft	
193–198	460	85.4	11.8	do	do	do	do	do	
200–205	460	85.4	12.2	do	do			do	
207–208	470	85.4	11.9			Yellow	None	do	2.15 p. m. given 122 c. c. 20 per cent alcohol (by volume).
209	460	85.4				Brown	do	do	2 p. m. given 183 c. c. 20 per cent alcohol.
210	480	85.4	11.4			Light brown	do	do	2 p. m. given 183 c. c. 30 per cent alcohol.
211	470	85.4				Brown	do	do	2 p. m. given 210 c. c. 30 per cent alcohol.
212	280	85.4				do	do	do	1. 15 p. m. given 244 c. c. 40 per cent alcohol. Marked intoxication.
214			10.9						8 a. m. found dead.

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TABLE 25—Continued.

DOG 28—Continued.

Day of experiment.	Hb.	Red cells per c. mm.	Reticulated reds.	White cells per c.mm.	Differential count.						Nucleated reds.	Character of reds.	Blood volume.		Plasma.				Clot.
					Small monos.	Large monos.	Pmn. n.	Pmn. eos.	Pmn. bas.	Tr.			Plasma.	Total.	Character.	Per cent.	Hemolysis.	Webster's reaction.	
	P. ct.				*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*			*c. c.*	*c. c.*					
1	105	7,848,000	2	14,000	14	6	58	22	.....	.....	0	Normal.....	751	1,533	Water, clear.....	49	None..	Negative	Firm.
4	96																		
9	84																		
12	78	8,080,000	6	17,600	12	.....	83	5	.....	.....	4	Anisocytosis.....	794	1,301	Amber, clear.....	61	None..	+Slight.	Do.
18	76																		
23	76																		
26	82	6,288,000	14	6,400	7	4	86	3	.....	.....	1	Anisocytosis.....	641	1,125	Light brown, clear	57	None..	+Slight.	Do.
30	77																		
33	72																		
37	78																		
42	76	5,960,000	10	10,000	17	4	68	10	.....	1	0	Normal.....	675	1,089	Amber, yellow....	62	None..	+Slight.	Do.
45	73																		
49	65																		
56	70																		
68	75																		
73	73																		
76	73	4,864,000	.....	21,000	5	2	86	.....	2.5	4.5	0	Slight anisocytosis	700	1,094	Accidental hemolysis.	64	None..	Negative	Do.
84	72																		
90	65	3,984,000	.....	10,200	12	1	83	.....	3.5	.5	0	Normal.....	669	998	Amber, clear.....	67	None..	Negative	Do.
97	66																		
101	69																		
105	60																		
110	66																		
113	66	4,344,000	.....	11,000	25.5	5.5	66	.....	.....	3	0	Anisocytosis.....	877	1,349	Light amber.....	65	None..	Negative	Do.

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[Diet changed to cooked fat beef containing 20 grams calcium phosphate per kilo.]

126	55	3,496,000	.....	10,050	6	13	79	1.5	.....	0.5	0	Normal.....	.....	.....	.....	70	None....	.....	Firm.
129	61	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
139	64	3,848,000	.....	14,000	9	1.5	85	1.5	.....	3	0	Normal.....	800	1,176	Amber, clear.....	68	None....	.....	Do.
150	65	3,096,000	.....	19,600	12	4	84	.....	.....	.....	2	Slight anisocytosis	.....	.....	....do.....	68	...do....	.....	Do.
159	57	3,344,000	.....	23,600	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
162	40	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
181	42	3,280,000	.....	14,000	12.5	2	84	.5	1	.....	1	Anisocytosis.....	850	1,118	Slight lipaemia...	76	None....	.....	Do.
207	56	3,392,000	.....	6,800	7	2	89	1	.....	1	1	Normal.....	933	1,388	Amber, clear.....	67	...do....	.....	Do.
210	51	3,728,000	.....	15,400	12	0	84	.5	2.5	1	0	.....do.....	.....	.....	Lipaemia	67	...do....	.....	Do.

February 17, 1919—Autopsy.—Animal is emaciated and very mangy. No icterus. Mucous membrane of mouth and conjunctivae are intact. No increase of serous fluids. Heart greatly dilated. Lungs quite normal. Stomach and intestines are apparently normal. Pancreas and adrenals are nomal. Kidneys are swollen and pale. Capsule is thin and strips with ease. On cut section the capsule bulges, striations are regular although somewhat obscured. Miscroscopically the kidney cells are swollen and very granular. Many of the glomerular tufts are collapsed and the lumina of the glomerular capsules are filled with hyaline-like material. Spleen is normal in size. On section the pulp is purplish-red, velvety and scrapes with ease. Miscroscopically the venules and pulp are congested. The pulp contains a few mononuclear phagocytes loaded with coarsely granular hemosidering. Bone-marrow of femur is dark red and granular. Microscopically it is hyperplastic and contains a few pigmented phagocytes. Liver is large and pale. On section the lobulation is distinct. The gall bladder is normal and contains 15 c. c. of clear light brown bile. The gall ducts are normal. Microscopically the liver cells are swollen and granular. No scarring. Very few pigmented phagocytes.

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TABLE 26.

[10 mg. T. N. T. (No. 4 crude) per kilo, per os. Total amount T. N. T. given=29.3 grams.]

DOG 17.

[Bread and milk diet followed by meat and calcium phosphate. Bread and milk diet 34 days before beginning experiment.]

Day of experiment.	Food eaten daily (gms.).	T. N. T. given.	Body weight.	Clinical symptoms.		Color.	Urine.		Feces.	Remarks.
				Character of mucous membranes.	Incoordination.		Bile pigment.	Webster's reaction.		
		Mg.	*Kilos.*							
1	400 bread, 400 milk	175	17.5	Normal	None		None	Negative		Adult bull mongrel, male. Active and normal.
2	do	175		do	do	Amber	do	+Slight		Excellent condition.
4	do			Slight cyanosis	Marked	do	+	Negative		
5–6	do	175		Normal	Present	do	None	do	Diarrhea	
8–9	do	175	16.9	do	Slight		+	do	do	
11	do	175		do	do				do	
13–16	do	175	17.1	do	do		None		do	
18–23	do	175	16.5	do	None		+	Negative	do	
25–30	330 bread, 330 milk	175	16.1	do	Slight		+	do	do	Slight salivation.
32–37	400 bread, 400 milk	175	16.1	Slight cyanosis	None		+Slight	do	do	Do.
39–44	do	175	15.6	do	do		+	do	do	Do.
46–51	300 bread, 300 milk	175	15.5	Pale pink	do		+Slight		do	Do.
53–58	do	175	14.6	Oral mucous membrane ulcerated.	do		do		do	Marked salivation. Superficial ulceration of oral mucous membrane. Foul breath.
60–65	350 bread, 350 milk	175	15	Pale pink	Slight		None		do	Salivation. Oral mucous membrane intact.
67–72	375 bread, 375 milk	175	15.2	do	None		+		do	
74–79	350 bread, 350 milk	175	14.6	do	do	Yellow	++		do	Slight salivation.
81–86	do	175	14.3	do	do	Light brown	+		do	Do.
88–93	375 bread, 375 milk	175	14.6	do	do	do	++		do	Slight salivation. Lively, rather thin.
95–100	do	175	14.2	do	do	Brown	+		do	Slight salivation.
102–107	250 bread, 250 milk	175	12.4	Oral mucous membrane ulcerated.	Slight	Light brown	++		do	Marked salivation. Very foul breath.
109–114	do	175	11.9	Pale pink	do	Brown	+		do	Foul breath. Oral mucous membrane intact.
116–121	300 bread, 300 milk	175	11.8	do	do	do	++		do	Marked salivation. Oral mucous membrane intact.
123–128	do	175	12.2	do	do	Light brown	+		do	Droopy. Marked salivation.
130–135	do	175	11.8	do	do	do	+		do	Do.
137–142	350 bread, 350 milk	175	11.7	do	do	do	+Slight		do	Emaciated. Beginning mange.
144–145	400 bread, 400 milk	175	11.8	do	None	Yellow	None		do	

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[Diet changed to cooked fat beef containing 20 grams calcium phosphate per kilo.]

146–149	500	175		Pale pink	None	Light brown	None		Soft	
151–153	495	175	11.9	do	do	Brown	+++		Diarrhea	
154–156	500	175	12.4	do	do	Dark brown	++		Soft	
158–163	480	175	12.3	do	do	Brown	+Slight		Diarrhea	
165–170	480	175	12.6	do	do		None		do	Fairly well nourished. Extensive mange.
172–177	435	175	12.9	do	do	Light brown	++		Soft	
179–180	485	175	12.8	do	do	do	None		do	
182–184	500	175	12.4	do	do				do	
186–187	500	175	13	do	do				do	Droopy.
189–191	485	175		do	do	Brown	None		do	
193–198	470	175	13.3	do	do	do	+		do	
200–205	460	175	13.5	do	do	Dark brown	+		do	
207–212	460	175	13.4	do	do	do	++		do	
214–219	412	175	12.9	do	do	Yellow	None		do	Very weak.
221	100	175	10.7						do	
222										Found dead.

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TABLE 26—Continued.

DOG 17—Continued.

Day of experiment.	Hb.	Red cells. per c. mm.	Reticulated reds.	White cells per c. mm.	Differential count.					Nucleated reds.	Character of reds.	Blood volume.		Plasma.				Clot.
					Small monos.	Large monos.	Pmn. n.	Pmn. eos.	Tr.			Plasma.	Total.	Character.	Per cent.	Hemolysis.	Webster's reaction.	
	P. ct.				*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*			*c. c.*	*c. c.*					
1	110	6,600,000	4	28,200	35	16	44	.....	5	0	Normal.....	796	1,592	Water, clear	50	None..	Negative	Firm.
5	92																	
12	92	6,104,000	25	7,700	25	7	66	.....	2	1	Normal.....	769	1,475	Amber, clear	52	None.	Negative	Do.
19	86																	
23	90																	
27	87	7,960,000	10	20,200	16	6	76	1	1	27	Basophilia, marked anisocytosis.	790	1,351	Light brown, clear..	58	None..	Negative	Do.
31	75																	
36	66																	
43	70	7,592,000	18	10,400	18	2	75	4	1	0	Basophilia, anisocytosis.	711	1,269	Amber, clear	56	None..	Negative	Do.
50	68																	
56	72	7,256,000	14	11,200	32	1	61	4	2	1	Anisocytosis.....	682	1,218	Amber, clear	56	None..	+Slight.	Do.
58	67																	
62	72																	
66	69																	
72	68														59	None..	Negative	Do.
77	73																	
89	81																	
94	79																	
97	75	5,664,000	.....	11,200	4.5	7.5	80.5	.....	7.5	0	Slight anisocytosis..	753	1,276	Amber, clear	59	None..	Negative	Do.
105	67																	
111	52	3,520,000	.....	21,000	13	3	82	.....	2	0	Normal.....	732	1,076	Amber, clear	68	None..	Negative	Do.
112	51																	
118	46																	
123	47																	
[illegible]	46																	
[illegible]	57																	
[illegible]	62	4,684,000	.....	8,400	30.5	2.5	65	.....	2	0	Normal.....	910	1,400	Amber.....	65	.....	.....	Do.

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[Diet changed to cooked fat beef containing 20 grams calcium phosphate per kilo.]

146–147	65	5,528,000	.....	9,100	5	18.5	72	0.5	4	0	Normal.....	793	1,220	Amber.....	65	.....	.....	Firm.
150	56	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
160	68	5,120,000	.....	11,200	18.5	1.5	80	.....	.....	0	Normal.....	724	1,114	Clear.....	65	.....	.....	Do.
171	56	4,032,000	.....	10,800	7	1	92	.....	.....	0	Slight anisocytosis..	.....	.....	Amber, clear.....	65	.....	.....	Do.
180	57	3,808,000	.....	11,600	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
183	52	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Water, clear.....	73	.....	.....	Do.
201	41	3,160,000	.....	11,000	2	13.5	82.5	1	1	0	Slight anisocytosis..	900	1,216	Slight lipæmia.....	74	.....	.....	Do.

Jan. 5, 1919.—Autopsy.—Dog is thin. Mucous membrane of mouth and conjunctivæ are intact. No icterus. Serous cavities normal. Heart and lungs normal. Pancreas normal. Left kidney is swollen, pale, and oedematous. Microscopically the tubular cells are swollen and granular. Right kidney presents a typical picture of a very acute diffuss nephritis with extensive polymorphonuclear leucocyte infiltration. Spleen appears normal in gross. Microscopically it is rich in cells of smooth outline and large single nucleuse No pigmentation. Mesenteric lymph glands appear normal in gross. Microscopically the sinuses are filled with coagulated and granular fluid. There are many large loose wandering cells and leucocytes. Bone marrow of femur is dark red and granular. Microscopically it is hyperplastic, partly fatty, and contains no pigment. Liver is large, pale, and oedematous. Gall bladder and bile ducts are normal. Microscopically the liver shows no scarring. No pigmented phagocytes. There is great dilation of the lymphatics and some general oedema.

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TABLE 27.

[16.5 mg. T. N. T. (No. 4 crude) per kilo, per os. Total amount T. N. T. given=21.65 grams.]

DOG 15.

[Bread and milk diet. Bread and milk diet 20 days before beginning experiment.]

Day of experiment.	Food eaten daily (grams).	T. N. T. given.	Body weight.	Clinical symptoms.		Urine.				Feces.	Remarks.
				Character of mucous membranes.	Incoordination.	Color.	Volume.	Bile pigment.	Webster's reaction.		
		Mg.	*Kilos.*				*c. c.*				
1–2	300 bread, 300 milk.	246	14.9	Normal	None	Amber	450	None	+Slight		Adult bull mongrel, male. Excellent condition.
4	do			do	do	do	1,244	+	Negative		
5–6	do	246	14.3	Slight cyanosis	Slight	do	450	+	do	Diarrhea	Very active.
8–9	225 bread, 225 milk.	246	13.8	Normal	do		350	+	do	do	
11	150 bread, 150 milk.	246	13.4	do	Present		400	None		Soft	
13–16	do	246	13.0	do	Slight		300	+	Negative	do	
18–23	210 bread, 210 milk.	246	12.2	do	do		550	++	do	do	
25–30	300 bread, 300 milk.	246	12.0	do	do		550	+	do	do	Slight salivation.
32–37	do	246	12.0	do	None			+Slight	do	Diarrhea	Do.
39–44	260 bread, 260 milk.	246	11.7	do	Slight			+	do	do	Weak and thin.
46–51	300 bread, 300 milk.	246	11.5	Slight icterus	None			+	do	do	Slight salivation.
53–58	250 bread, 250 milk.	246	11.0	do	do			++		do	Do.
60–65	350 bread, 350 milk.	246	11.5	do	do			+Slight		do	
67–72	do	246	11.5	Slight cyanosis	do			do		do	
74–79	315 bread, 315 milk.	246	11.5	Pale pink	do	Light brown		++	Negative	do	
81–86	325 bread, 325 milk.	246	11.3	do	do	do		++	do	do	
88–93	300 bread, 300 milk.	246	11.6	Pale, slight icterus	Slight	do		++	do	do	
95–100	do	246	11.4	Pale pink	do	do		++	do	do	Emaciated. Fairly lively.
102–106	245 bread, 245 milk.	246	10.5	Mucous membrane of mouth ulcerated.	do	do		++	do	do	Extensive superficial ulceration of oral mucous membrane. Extreme salivation. Very foul breath.
108	None		9.3	do							2.30 p. m., found dead.

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Day of experiment.	Hb.	Red cells per c. mm.	Reticulated reds.	White cells per c. mm.	Differential count.						Nucleated reds.	Character of reds.	Blood volume.		Plasma.				Clot.
					Small monos.	Large monos.	Pmn. n.	Pmn. eos.	Pmn. bas.	Tr.			Plasma.	Total.	Character.	Per cent.	Hemolysis.	Webster's reaction.	
	Per cent.				*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*			*c. c.*	*c. c.*					
1	117	6,840,000	12	10,050	26	7	67	.....	.....	.....	0	Normal.....	727	1,454	Water, clear..	50	None..	Negative	Firm.
5	102	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	624	1,114	Amber, clear..	56	None..	Negative	Do.
12	101	5,576,000	40	10,800	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
14	91	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
15	90	.....	.....	.....	14	8	73	2	.....	3	0	Anisocytosis.....	.....	.....	.....	.....	.....	.....	.....
22	75	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
26	83	8,376,000	96	21,800	1.5	3	90	4	.....	1.5	7	Anisocytosis.....	560	982	Light brown, clear.	57	None..	Negative	Do.
30	79	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
35	78	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
37	93	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
42	93	10,024,000	11	10,200	18	1	76	3	.....	2	0	Anisocytosis, basophilia.	632	1,109	Amber, clear..	57	None..	Negative	Do.
46	78	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
49	62	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
51	69	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
55	71	5,360,000	40	22,400	6	3	85	4	.....	2	7	Anisocytosis.....	663	990	Amber, clear..	67	None..	+Slight.	Do.
57	60	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
61	62	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
65	77	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
71	82	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
76	83	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Amber, clear..	55	None..	Negative	Do.
88	80	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
93	66	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
96	72	4,616,000	.....	12,800	8	1	88	.....	2	1	0	Anisocytosis.....	611	1,036	Amber, clear..	59	None..	Negative	Do.
104	58	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
106	63	3,992,000	.....	4,200	31	6	62	.....	.....	1	4	Anisocytosis.....	553	813	Amber, clear..	68	None..	Negative	Do.

October 12, 1918.—Autopsy.—Dog is emaciated and very weak. Extensive superficial ulceration of oral mucous membrane and under surface and sides of tongue. Mucous membrane desquamating in long shreds. Conjunctivæ are normal in color. Skin is intact, except for three decubitus ulcers over buttocks. No icterus. Subcutaneous and omental fats are scanty and normal in color. Serous cavities are normal. Heart and lungs normal. Stomach is filled with bile-stained mucus. Mucosa is normal. The mucosa of upper part of small intestine is engorged and covered with heavily bile-stained mucus. The muscular layers of the entire small intestine are snuff-colored. The colon is normal. Pancreas, adrenals, and kidneys are normal. Spleen is small and shows increased pigmentation. Microscopically it shows atrophy of the substance as judged by the concentration of the trabeculae. Venules are distinct. The intervening tissue is solid and composed of rather large mononuclear cells with few red corpuscles. Some Malpighian bodies show necrosis and fragmentation of cells. Much hemosiderin is present in the large mononuclear phagocytic cells. Mesenteric lymph glands are not especially abnormal. The endothelial cells in the sinuses form a dense network often containing a moderate amount of rather fine hemosiderin. Bone marrow of femur is dark red and granular and extends well down into the shaft of the bone. Microscopically it is hyperplastic. Solid strands of cells and very distinct venules. No fat. Many phagocytic cells loaded with hemosiderin. Liver is small and anemic. The capsule is slightly roughened. On section the lobules are quite distinctly outlined with reddish brown centers and dull grayish brown peripheries. There are many pin point to pin head highly pigmented areas scattered irregularly through the parenchyma. The gall bladder is normal and contains 4.5 c. c. of very dark stringy bile. The bile ducts appear normal. Microscopically the liver shows no increase of scar tissue nor any distortion. The capillaries are found to contain many swollen Kupffer cells loaded with pigment. About the portal spaces are mononuclear cells some of which are full of hemosiderin—probably wandering cells.

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TABLE 28.

[20 mg. T. N. T. (No. 7 pure) per kilo, in olive oil, intraperitoneally. One dose only.]

DOG 63.

[Meat diet.]

Day of experiment.	Time.	Food eaten daily.	Body weight.	Temperature (rectal).	Clinical symptoms.		Urine.					Feces.	Remarks.
					Character of mucous membranes.	Incoordination.	Color.	Albumin.	Fehling's test.	Bile pigment.	Webster's reaction.		
	A. M.	*Gms.*	*Kilos.*	*° C.*									
1	9.00	400	11.3	.....	Bright pink.....	.....	Light amber.....	None..	Negative..	None..	.....	Hard.....	Young adult cur, male. Active and normal.
	10.15	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Given 226 mg. T. N. T. in olive oil intraperitoneally.
	11.00	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	500 c. c. water by stomach tube.
	M.												
	12.00	.....	.....	38.2	.....	.....	.....	.....	.....	.....	.....	.....	
	P. M.												
	12.15	.....	.....	.....	.....	.....	Brilliant red.....	None..	Negative..	None..	++.....	.....	Urine shows absorption of green, blue, violet end of spectrum. No oxyhemoglobin bands.
	12.45	.....	.....	.....	Normal.....	None..	.....	.....	.....	.....	.....	.....	
	2.15	.....	.....	.....	.....	.....	Reddish orange.....	None..	.....	.....	.....	.....	Pulse 180 regular.
	3.00	.....	.....	38.3	Normal.....	None..	.....	.....	.....	.....	.....	.....	
	4.30	.....	.....	.....	....do.....	...do...	.....	.....	.....	.....	.....	.....	Pulse 180 regular. Tongue dry, reddish brown color.
2	.....	310	11.3	37.9	Pale pink.....	Slight.	Amber, clear.....	.....	.....	None..	Negative..	Diarrhea..	Pulse 160. Tongue dry, reddish brown. Conjunctivae normal.
3– 6	.....	390	11.6	38.3	....do.....	None..	Dark brown.....	.....	.....	...do...	...do.....	Hard.....	
7– 8	.....	400	.....	.....	Pink.....	...do...	.....	.....	.....	...do...	...do.....	...do.....	Abdominal wall soft.
9– 17	.....	370	11.4	.....	Pale.....	...do...	Yellow.....	.....	.....	...do...	.....	...do.....	
19– 69	.....	395	12	.....	Very pale.....	...do...	....do.....	.....	.....	...do...	.....	...do.....	
70–130	.....	385	12.2	.....	Pale.....	...do...	Straw.....	.....	.....	...do...	.....	...do.....	
131–175	.....	.....	11.9	.....	Normal.....	.....	.....	.....	.....	.....	.....	.....	In excellent condition. Killed with chloroform on 175th day.

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Day of experiment.	Time.	Hb.	Red cells per c. mm.	White cells per c. mm.	Differential count.					Nucleated reds.	Character of reds.	Blood volume.		Plasma.				Methb.	Clot.
					Small monos.	Large monos.	Pmn. n.	Pmn. eos.	Tr.			Plasma.	Total.	Character.	Per cent.	Hemolysis.	Webster's reaction.		
	A. M.	*P. ct.*			*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*			*c. c.*	*c. c.*						
1	9.00	101	7,200,000	7,200	4	2	87	5	2	0	Marked anisocytosis.	532	1,157	Amber, clear..	46	None..	Negative	None....	Firm.
	P. M.																		
	12.15	88	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Lipaemia+...	58	...do...	+	++++.	
	2.15	92	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	+++...	Do.
	4.15	91	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Lipaemia+...	51	None..	++	+++...	Do.
2	.....	89	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Lipaemia +++.	55	...do...	Negative	None....	Do.
7	.....	90	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	....do.....	50	...do...	...do.....	...do.....	Do.
9	.....	93	6,496,000	12,200	11	6	80	.....	3	0	Normal.....	546	1,011	Amber, clear..	54	...do...	...do.....	...do.....	Do.
19	.....	94	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
20	.....	92	6,104,000	15,000	18	5	74	.....	3	0	Normal.....	517	957	Water, clear..	54	None..	Negative	None....	Do.
24	.....	79	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
31	.....	79	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Amber, clear..	60	None..	Negative	None....	Do.
35	.....	85	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
36	.....	89	6,280,000	10,800	20	.....	77.5	.....	2.5	0	Normal.....	552	968	Water, clear..	57	None..	Negative	None....	Do.
44	.....	75	5,616,000	13,600	5.5	.5	94	.....	.....	1	Anisocytosis, poikilocytosis.	.....	.....	....do.....	61	...do...	...do.....	...do.....	Do.
49	.....	69	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
54	.....	71	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
57	.....	75	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
62	.....	76	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
68	.....	71	6,152,000	10,000	1	14	75	8.5	1.5	0	Normal.....	615	1,042	Clear.....	59	.....	.....	.....	
80	.....	68	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
90	.....	72	5,968,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
104	.....	76	6,144,000	14,200	.....	18	79	.....	3	0	Normal.....	.....	.....	Slight lipaemia.	51	.....	.....	.....	
134	.....	81	6,296,000	6,400	6.5	2.5	89	1	1	0	.....	624	1,200	Pale amber, clear.	52	.....	.....	.....	
174	.....	94	6,904,000	7,200	16.5	5	77	.....	.5	1	Normal.....	626	1,138	Lipaemia.....	55	.....	.....	.....	

February 26, 1919.—Autopsy.—Dog is well nourished. Oral mucous membrane and conjunctivae are normal. Serous cavities normal. Heart and lungs normal. Stomach and intestines are normal. Pancreas, adrenals and kidneys are normal in gross and in sections. Spleen is of normal size and appearance. Microscopically the organ is normal and shows no increased pigmentation. Bone marrow is mottled gray and pink. Microscopically it consists mostly of fat cells. The hematoplastic islands are normal and do not contain any pigment-holding phagocytes. Mesenteric lymph glands are normal. Liver is normal in size. The capsule is thin. Lobulation is distinct. Gall bladder contains 15 c. c. light brown clear bile. Bile ducts are normal. Microscopically the liver cells are normal. The bile structures are unchanged.

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TABLE 29.

[20 mg. 2, 6-dinitro-4-hydroxylamino-toluene, per kilo, in olive oil, intraperitoneally. One dose only.]

DOG 66.

[Meat diet.]

Day of experiment.	Time.	Food eaten daily.	Body weight.	Clinical symptoms.		Urine.			Feces.	Remarks.
				Character of mucous membranes.	Incoordination.	Color.	Bile pigment.	Webster's reaction.		
1	A. M. 9.25	*Gms.*	*Kilos.* 10.5	Normal.....	None....	Light brown.....	None....	.....	Hard....	Young adult cur, bitch. 210 mg. hydroxylamine compound, in olive oil, intraperitoneally.
	10.40	.....		Bright pink.....	...do.....					
	11.30	.....	.....	Marked cyanosis.....	...do.....	Brown.....	None....	++.....	.....	Respiration 16. Pulse 160.
	P. M. 2.30	.....	.....	.....do.....	...do.....	Yellow.....	...do....	++.....	.....	Lively. Respiration 16. Pulse 160.
	4.15	.....	.....	.....do.....	...do.....					
2	.....	.....	10.3	Purplish pink, some cyanosis....	...do.....	Brown.....	None....	+	Soft....	Lively. Respiration 16. Pulse 140.
3–6	.....	360	9.9	Bright pink.....	...do.....	Light brown.....	...do....	Negative..	Hard....	Do.
8–46	.....	380	10.3	Normal.....	...do.....	Brown.....	...do.....	...do.....	Soft.....	Lively. Respiration 16. Pulse 172, regular.
47–52	.....	380	8.9	Pale pink.....	...do.....	.....do.....	.....	...do.....	Hard....	Good condition. Mange on hind legs.
53	A. M. 9.00	.....	8.3	.....	.....	.....	.....	.....	.....	Extensive mange. No other symptoms.
										Found dead.

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Day of experiment.	Time.	Hb.	Red cells per c. mm.	White cells per c. mm.	Differential count.					Nucleated reds.	Character of reds.	Blood volume.		Plasma.			Clot.
					Small monos.	Large monos.	Pmn. n.	Pmn. eos.	Tr.			Plasma.	Total.	Character.	Per cent.	Hemolysis.	
	A. M.	P. ct.			P. ct.	P. ct.	P. ct.	P. ct.	P. ct.			c. c.	c. c.				
1	10.10	92	6,688,000	18,000	4	7	87.5	.....	1.5	1	Normal.....	506	1,012	Clear.....	50	None..	Firm.
	P. M.																
	12.37	88	6,480,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	2.17	78	6,472,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	4.13	77	6,088,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	A. M.																
2	10.42	77	5,376,000	19,600	11.5	1	87	0.5	.....	11	Poikilocytosis.....	.....	.....	Amber.....	55	.....	
	P. M.																
	4.00	68	4,592,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	A. M.																
3	11.00	68	4,688,000	24,400	17.5	.5	82	.....	.....	22	Normal.....	502	784	Light amber.....	64	None..	Do.
6	.....	56	3,584,000	30,000	2	8	88	.....	2	45	Marked anisocytosis.....	.....	.....	.....	.....	.....	.....
8	.....	54	4,248,000	29,600	11	2.5	86	.....	.5	111	....do.....	541	832	Amber.....	65	None..	Do.
23	.....	71	4,960,000	12,600	12	.....	87	.....	1	2	Slight anisocytosis, poikilocytosis.	.....	.....	Lipaemia ++.....	61	.....	
33	.....	67	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Pale amber, clear.....	62	.....	
52	.....	91	5,848,000	15,800	5.5	1	92.5	.....	1	1	Anisocytosis, poikilocytosis.	400	755	Water, clear.....	53	None..	Do.

January 15, 1919.—Autopsy.—Dog is fairly well nourished. No icterus. Trachea is clear. Heart and lungs are negative. Stomach is empty. Mucosa of pylorus and duodenum is swollen, deep red and hemorrhagic. Kidneys are congested. Spleen appears normal. Bone marrow of femur is red throughout. Microscopically it is hyperplastic. It contains a considerable amount of fat. No pigment holding phagocytes. Liver is swollen, friable, and quite fatty. Gall bladder is distended with normal-looking bile. Microscopically the liver cells are swollen, granular, and contain many fat droplets. No scarring. Capillaries contain many leucocytes. No pigmented endothelial cells.

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TABLE 30.

[20 mg. 2, 6-dinitro-4-hydroxylamino-toluene, per kilo, in olive oil, intraperitoneally. One dose only.]

DOG 58.

[Meat diet.]

Day of experiment.	Time.	Food eaten daily.	Body weight.	Temperature (rectal).	Clinical symptoms.		Urine.					Feces.	Remarks.
					Character of mucous membranes.	Incoordination.	Color.	Albumin.	Fehling's test.	Bile pigment.	Webster's reaction.		
	A. M.	*Gms.*	*Kilos.*	*°C.*									
1	9.00	.....	9	.....	Normal.....	None.....	Straw.....	None..	Negative..	None....	.....	.....	Young adult terrier, mongrel, male. Active and normal.
	10.25	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	180 mg. hydroxylamine compound in 28 c. c. olive oil, intraperitoneally.
	10.50	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Given 400 c. c. water by stomach tube.
	P. M.[1]												
	12.30	.....	.....	38.3	Marked cyanosis, bluish gray.	None.....	Light yellow, clear.	None..	Negative..	None....	Negative..	Diarrhea..	Heart beat regular. Pulse 200.
	3.00	.....	.....	38.3	Cyanosis.....	.....do.....	Amber, cloudy.....	...do..	.....	...do.....	...do.....	Soft.....	Pulse 180, regular; lively.
	4.30	390	.....	38.2	.....do.....	.....do.....	.....	.....	.....	.....	.....	.....	Pulse 208, regular.
2	.....	320	.....	38.7	Normal.....	.....do.....	.....	.....	.....	.....	.....	Soft.....	Lively.
3–8	.....	385	8.5	.....	Pale pink.....	.....do.....	Straw.....	.....	.....	None....	.....	Diarrhea..	Do.
9–17	.....	360	8	.....	.....do.....	.....do.....	Light brown.....	.....	.....	...do....	.....	...do.....	
19–22	.....	380	7.3	.....	.....do.....	.....do.....	Yellow.....	.....	.....	+Slight..	.....	...do.....	
23	.....	310	.....	.....	.....do.....	Marked (weakness).	.....do.....	.....	.....	...do....	.....	Hard.....	Droopy, thin, stiffness of jaws. Tremors of neck and jaw muscles.
24	.....	0	.....	.....	.....do.....	.....do.....	.....	.....	.....	.....	.....	Diarrhea..	Weak. Nervous type of distemper.
25	.....	.....	6.7	.....	.....	.....	.....	.....	.....	.....	.....	.....	9.30 a. m. found dead.

[1] Urine shows no oxyhaemoglobin bands. Absorption of one-half of green, blue and violet end of spectrum.

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Day of experiment.	Time.	Hb.	Red cells per c.mm.	White cells, per c. mm.	Differential count.					Nucleated reds.	Character of reds.	Blood volume.		Plasma.				Methb.	Clot.
					Small monos.	Large monos.	Pmn. n.	Pmn. eos.	Tr.			Plasma.	Total.	Character.	Per cent.	Hemolysis.	Webster's reaction.		
	A. M.	*Per cent.*			*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*			*c. c.*	*c. c.*						
1	9.00	110	6,184,000	18,400	6	1	90	2	1	0	Slight anisocytosis.	461	912	Amber, clear...	51	None..	Negative	None....	Firm.
	P. M.																		
	12.15	101	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Lemon yellow, lipaemia.	49	..do....	++.....	++++.	Do.
	2.15	96	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	++++.	
	4.15	100	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Pale yellow, lipaemia.	46	None..	Negative	++++.	Do.
2	.....	100	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Water, clear....	46	..do....	+Slight..	None....	Do.
7	.....	77	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....do.....	61	..do....	Negative	...do.....	Do.
9	.....	83	4,672,000	34,200	7	4	87	.....	2	6	Normal.....	431	742	.....do.....	58	..do....	...do.....	...do.....	Do.
19	.....	81	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
20	.....	84	4,832,000	33,900	3	1.5	91.5	.....	4	0	Slight anisocytosis.	370	649	Water, clear....	57	None..	Negative	None....	Do.
24	.....	69	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

September 30, 1918—Autopsy.—Dog is emaciated. Oral mucous membrane and conjunctivae are intact and normal. No icterus. Serous surfaces are smooth. Trachea is clear. Heart and lungs normal. Mucosa of jejunum, ileum and colon is swollen and pinkish-red in color. Kidneys are normal in gross and in sections. Spleen is atrophic. The pulp is purplish-red and velvety. Microscopically the trabeculae are concentrated. The venules are distended. The pulp contains no pigmented phagocytes. Bone marrow of femur is mottled gray and red. Microscopically it is hyperplastic. Considerable fat. No pigment-holding phagocytes. Liver is congested. Gall bladder is distended with normal-looking bile. Bile ducts are normal. Microscopically the capillaries are distended with red corpuscles. Liver cells appear normal. No scarring. No pigment.

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TABLE 31.

[20 mg. 2, 6-dinitro-azoxy-toluene per kilo, in olive oil, intraperitoneally. One dose only.]

DOG 67.

[Bread and milk diet. Bread and milk diet 46 days before beginning experiment.]

Day of experiment.	Time.	Food eaten daily (gms.).	Body weight.	Clinical symptoms.		Urine.			Feces.	Remarks.
				Character of mucous membranes.	Incoordination.	Color.	Bile pigment.	Webster's reaction.		
	A. M.		*Kilos.*							
1	10.18		9.2	Pink	None	Light brown	+Slight	Negative		Old fox terrier mongrel, male. 184 mg. azoxy compound, in olive oil, intraperitoneally.
	11.30			do	do	do	do	do		Pulse 176. Respiration 24.
	P. M.									
	2.30			Slight cyanosis	do	do				
	4.15			Purple	do	do				Pulse 202. Respiration 25.
2		300 bread, 300 milk		Pink	do	Yellow	Negative	Negative	Soft	Pulse 144. Respiration 25.
3–4		do	8.8	do	do	do	do	do	do	
5–6		do	9.2	do	do	Light brown	+Slight	do	Diarrhea	Pulse 116, irregular. Respiration 20.
7–8		do	8.9	do	do	do	Negative	do	Hard	
9–12		225 bread, 225 milk	8.8	do	do	do	do	do	Soft	No obvious symptoms, except ulceration of oral mucous membrane.
13		None		Intensely ulcerated		do	do		Hard	
15		do	8.8	do					None	Died.

Day of experiment.	Time.	Hb.	Red cells per c. mm.	White cells per c. mm.	Differential count.					Nucleated reds.	Character of reds.	Blood volume.		Plasma.			Clot.
					Small monos.	Large monos.	Pmn. n.	Pmn. eos.	Tr.			Plasma.	Total.	Character.	Per cent.	Hemolysis.	
	A. M.	*Per ct.*			*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*			c. c.	c. c.				
1	10.15	97	7,022,000	13,800	6.5	10	78.5	1	4	0	Normal	510	981	Clear	52	None	Firm.
	P. M.																
	12.30	91	6,840,000														
	2.20	89	6,624,000														
	4.14	85	6,440,000														
2		87	5,928,000	16,600	7.5	1.5	89.5	1.5		0	Normal			Clear	55	None	Do.
3		79	5,080,000	13,000	11.5		88		.5	0	do	510	773	do	66	do	Do.
6		82	5,552,000	10,000	2	12	85		1	1	Anisocytosis, slight poikilocytosis						
8		69	5,718,000	7,800	6	20	72		2	0	Anisocytosis	488	800	Clear	61	None	Do.

December 9, 1918.—Autopsy.—Dog is well nourished. Skin is normal. Oral mucous membrane is covered with superficial ulcerations. Conjunctivae are intact. Subcutaneous tissues are pale. No icterus. Heart and lungs are negative. Stomach mucosa is swollen, deep red and hemorrhagic. Spleen is normal in size and appearance. Microscopically the pulp contains a few pigment-holding phagocytes. Kidneys are normal in gross and in sections. Liver is not enlarged and is normal in appearance. Gall bladder is distended with clear light-brown bile. Microscopically the liver cells are normal. No scarring. No pigmented phagocytes. Bone marrow of femur is mottled gray and pink. Microscopically it is chiefly fat with very little myeloid tissue. It contains no pigment-holding phagocytes.

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TABLE 32.

[20 mg. 2, 6-dinitro-azoxy-toluene, per kilo, in olive oil, intraperitoneally. One dose only.

DOG 72.

[Meat diet for four months previous to beginning experiment.]

Day of experiment.	Time.	Hb.	Red cells per c. mm.	White cells per c. mm.	Differential count.						Nucleated reds.	Character of reds.	Blood volume.		Plasma.		Body weight.	Clinical symptoms.	Urine.		Remarks.
					Small monos.	Large monos.	Pmn. n.	Pmn. eos.	Pmn. bas.	Tr.			Plasma.	Total.	Character.	Per cent.			Color.	Bile pigment.	
	A. M.	*Per cent.*			*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*			c. c.	c. c.			*Kilos.*				
1	10.30	101	7,416,000	8,800	2	9	89	.....	.....	.....	0	Normal	464	1,009	Clear..	46	10.2	None	Light yellow.	None.	Young adult, bull, mongrel, male.
	10.45	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	204 mg. azoxy compound in olive oil, intraperitoneally.
	P. M.																				
	12.30	102	7,269,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Pulse 88. Respiration 20.
	2.15	99	5,296,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
	4.00	97	7,032,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	None	.....	.....	
2	.....	106	7,096,000	21,000	3	4.5	91	0.5	.....	1	0	Normal	352	782	Clear..	45	10.2	..do..	Yellow.	None.	Pulse 160. Respiration 20.
3	.....	98	7,288,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	..do..	.....	.....	
5	.....	102	6,904,000	13,600	6.5	8.5	82	1.5	0.5	1	5	Normal	.....	.....	.....	48	.....	..do..	Reddish brown.	+++	
8	.....	92	6,376,000	4,400	.....	17	79	1	1	2	6	Anisocytosis.	.....	.....	.....	51	10.2	..do..	...do...	+++	
20	.....	99	6,072,000	9,000	1	13	85	.....	1	.....	20	..do...	330	660	Amber, clear.	50	8.0	..do..	Light brown.	+	12.30 p. m. killed with chloroform.

February 26, 1919.—Autopsy.—Dog is fairly well nourished. No icterus. Serous cavities are smooth. Heart and lungs are negative. Stomach, intestines, pancreas, adrenals, and kidneys show nothing abnormal. Spleen is normal in size. The cut section has a brownish-red appearance. Microscopically the venules are distended with red cells. Pulp contains many megalocaryocytes and normoblasts. Also numerous phagocytes loaded with hemosiderin. Bone marrow is mottled gray and brownish red. Microscopically it is moderately hyperplastic and contains a great many pigment-holding phagocytes. Liver appears normal in gross. Gall bladder is distended with 23 c. c. dark brown, clear bile. Bile ducts are normal. Microscopically the liver cells appear normal. No scarring. No pigment. Many small accumulations of polyblasts in capillaries.

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TABLE 33.

[20 mg. 2, 6-dinitro-para-toluidine, per kilo, in olive oil, intraperitoneally. One dose only.]

DOG 59.

[Meat diet.]

Day of experiment.	Time.	Food eaten daily.	Body weight.	Temperature (rectal).	Clinical symptoms.		Urine.					Feces.	Remarks.
					Character of mucous membranes.	Incoordination.	Color.	Albumin.	Fehling's test.	Bile pigment.	Webster's reaction.		
1	A. M. 9.00	*Gms.*	*Kilos.* 9.5	°*C.*	Normal.	None..	Amber, cloudy.....	+Slight.	Negative..	None.....	.....	.....	Adult, fox terrier, mongrel, bitch.
	10.29	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	190 mg. dinitro-para-toluidine in 30 c. c. olive oil intraperitoneally.
	10.52	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Given water by stomach tube.
	P. M. 12.30	.....	.....	37.5	Normal.	None..	Amber, cloudy.....	++++	Negative..	None.....	Negative..	.....	Lively. Pulse 104, regular. Tongue dry, reddish brown.
	3.30	.....	.....	37.8	...do.....	...do..	Reddish yellow, clear..	++.....	.....	...do.....	...do.....	Diarrhea..	Pulse 112, irregular. Good volume and tension.
	4.30	385	.....	38.6	...do.....	...do..	Yellow, cloudy.....	.....	.....	+Slight...	.....	.....	Pulse 120, irregular. Tongue dry, reddish brown.
2	.....	400	9.5	38	...do.....	...do..	Amber, cloudy.....	*	.....	None.....	Negative..	Soft.....	Lively. Tongue dark brownish red, dry.
3–6	.....	325	9.4	32	...do.....	...do..	Yellow.....	.....	.....	...do.....	.....	Hard.....	Abdomen soft. Tongue reddish brown, moist.
7–31	.....	350	9.9	.....	...do.....	...do..	Straw.....	.....	.....	...do.....	.....	...do.....	
33–61	.....	375	10.5	.....	...do.....	...do..	.....do.....	.....	.....	...do.....	.....	...do.....	
62	.....	310	9.7	.....	...do.....	...do..	.....	.....	.....	...do.....	.....	...do.....	
63–174	.....	325	9.0	.....	...do.....	...do..	Light brown.....	.....	.....	.....	.....	Soft.....	Gives birth to five puppies.
175	.....	.....	8.7	.....	.....	.....	.....	.....	.....	None.....	.....	...do.....	In excellent condition.
													Active and normal. 11 a. m. killed with chloroform.

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Day of experiment.	Time.	Hb.	Red cells per c. mm.	White cells per c. mm.	Differential count.						Nucleated reds.	Character of reds.	Blood volume.		Plasma.				Methb.	Clot.
					Small monos.	Large monos.	Pmn. n.	Pmn. eos.	Pmn. bas.	Tr.			Plasma.	Total.	Character.	Per cent.	Hemolysis.	Webster's reaction.		
		P. ct.			*Per ct.*	*Per ct.*	*Per ct*	*Per ct.*	*Per ct.*	*Per ct.*			c. c.	c. c.						
1	A. M. 9.30	94	10,312,000	10,400	22	1	64	12	.....	1	0	Slight anisocytosis.	458	898	Amber, clear.	51	None.	Negative	None.	Firm.
	P. M. 12.15	78	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Lemon yellow, clear.	59	...do..	+++...	...do..	Do.
	2.15	75	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....do.....				...do..	
	4.15	79	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	57	None.	Negative	...do..	Do.
2	.....	81	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Lipæmia +++.	56	...do..	...do.....	...do..	Do.
7	.....	81	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Lipæmia++	55	...do..	...do.....	...do..	Do.
9	.....	81	6,784,000	15,800	10	3	84	2	.....	1	0	Slight anisocytosis.	490	831	Amber, clear.	59	...do..	...do.....	...do..	Do.
20	.....	81	6,480,000	15,800	26	9	64	.....	.....	1	0	Normal.....	492	848	Water, clear..	58	...do..	...do.....	...do..	Do.
24	.....	71	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
28	.....	76	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Amber, clear.	61	None.	Negative	None.	Do.
36	.....	82	6,904,000	19,400	16	1.5	78.5	.5	.....	3.5	0	Normal.....	518	909	Slight lipæmia.	57	...do..	...do.....	...do..	Do.
44	.....	72	5,352,000	15,600	17	1.5	79	.....	.....	2.5	1	.....do.....	535	863	Water, clear..	62	...do..	...do.....	...do..	Do.
49	.....	69	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
54	.....	68	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
57	.....	71	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
62	.....	63	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
70	.....	58	4,432,000	11,600	15.5	7	74.5	.....	1.5	1.5	8	Normal.....	546	867	Slight lipæmia.	63	.....	.....	.....	.....
80	.....	64	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
90	.....	61	5,400,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
103	.....	78	6,104,000	9,000	17	1	81	.....	.....	1	0	Anisocytosis, poikilocytosis.	.....	.....	Pale amber, clear.	58	.....	.....	.....	.....
134	.....	85	6,624,000	15,600	12.5	3	84	.....	.5	.....	1	Anisocytosis	477	917	.....do.....	52	.....	.....	.....	.....
174	.....	88	7,460,000	12,200	12	10	77	1	.....	.....	20	Normal.....	510	927	Amber, clear.	55	.....	.....	.....	.....

February 26, 1919.—Autopsy.—Dog is well nourished. Oral mucous membranes and conjunctivæ are intact and normal. No icterus. Serous surfaces are smooth and glistening. Heart and lungs are normal. Stomach, intestines, pancreas, adrenals, and kidneys are negative. Spleen is normal in size and appearance. Mesenteric lymph glands are normal in gross and in sections. Bone marrow is mottled gray and pink. Microscopically it contains a considerable amount of myeloid tissue. Liver is very fatty. Capsule is smooth. On cut section the lobules stand out very conspicuously with opaque grayish-brown centers and more translucent reddish-brown peripheries. The gall bladder and bile ducts appear normal. Microscopically there is an extensive central fatty change; about two-thirds of the liver cells are loaded with both large and small fat droplets. The liver cells surrounding the portal spaces appear normal. The bile ducts are normal.

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TABLE 34.

[20 mg. 6-nitro-2, 4-diamino-toluene, intraperitoneally. One dose only.]

DOG 62.

[Meat diet.]

Day of experiment.	Time.	Food eaten daily.	Body weight.	Temperature (rectal).	Clinical symptoms.		Urine.				Feces.	Remarks.
					Character of mucous membranes.	Incoordination.	Color.	Albumin.	Bile pigment.	Webster's reaction.		
1	A. M. 9.00	*Gms.* 175	*Kilos.* 8.9	°*C.*	Normal.....	None....	Amber, cloudy....	None..	None....	Negative	.....	Young adult terrier, mongrel bitch. Active and normal.
	10.42	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	178 mg. 6-nitro-2, 4-diamino-toluene in 35 c. c. olive oil; intraperitoneally.
	10.58	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	400 c. c. water by stomach tube.
	P. M. 12.15	.....	.....	38.4	Marked cyanosis.....	None....	Amber, cloudy....	None..	+Slight.	.....	.....	Pulse 160 regular.
	3.00	.....	.....	38.8	.....do.....	...do.....	.....do.....	...do...	None....	Negative	.....	Pulse 136 regular.
	4.30	.....	.....	38.4	.....do.....	...do.....	.....do.....	...do...	...do....	...do.....	Diarrhea..	Pulse 140 regular.
2–3	.....	320	8.1	38.2	Pale pink.....	...do.....	Straw, cloudy.....	...do...	...do.....	...do.....	None.....	
5–6	.....	300	7.5	37.9	.....do.....	Slight..	.....	.....	...do.....	.....	Hard.....	Weak. Foul breath. Ulcer 1 cm. in diameter opposite left molar tooth.
7	.....	300	.....	.....	.....	.....	.....	.....	.....	.....	.....	Gait restrained. Appears sick.
8–19	.....	300	6.7	.....	.....do.....	...do....	.....	.....	...do....	.....	...do.....	
20–56	.....	375	7.2	.....	.....do.....	None....	.....	.....	...do....	.....	...do.....	
57–125	.....	350	8	.....	.....	...do....	.....	.....	...do....	.....	...do.....	
126–173	.....	325	7.4	.....	Normal.....	...do....	Straw.....	.....	...do....	.....	...do.....	Emaciated.
174	.....	325	8.8	.....	.....do.....	...do....	Brown.....	.....	.....	.....	Soft.....	
175	.....	.....	8.9	.....	.....do.....	...do....	.....	.....	None....	.....	Hard.....	
					.....	.....	.....	.....	.....	.....	.....	Active and normal.
					.....	.....	.....	.....	.....	.....	.....	11.45 a. m. killed with chloroform.

Day of experiment.	Time.	Hb.	Red cells per c. mm.	White cells per c. mm.	Differential count.					Nucleated reds.	Character of reds.	Blood volume.		Plasma.				Methb.	Clot.
					Small monos.	Large monos.	Trans. P.	Pmn. eos.	Tr.			Plasma.	Total.	Character.	Per cent.	Hemolysis.	Webster's reaction.		
	A. M.	*Per cent.*			*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*			c. c.	c. c.						
1	9.00	105	7,384,000	11,800	15	5	79	.....	1	0	Normal.....	424	943	Amber, clear...	45	None .	Negative	None....	Firm.
	P. M.																		
	12.15	102	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Water, clear....	45	...do..	++.....	++++.	Do.
	2.15	102	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	++++.	
	4.15	96	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Amber, clear...	53	None .	+.....	++.....	Do.
2	.....	106	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Light brown, clear.	46	...do..	++.....	None....	Do.
7	.....	100	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Amber, clear...	51	...do..	+Slight.	...do.....	Do.
9	.....	97	6,816,000	7,800	18	2	77	.....	3	0	Normal.....	350	761	.....do.....	46	...do..	...do.....	...do.....	Do.
19	.....	88	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
20	.....	89	6,348,000	6,800	13	3	83	.....	1	0	Normal.....	305	508	Lipaemia +....	60	None .	Negative	None....	Do.
24	.....	68	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
31	.....	69	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Amber, clear...	63	None .	Negative	None....	Do.
36	.....	79	4,976,000	10,200	15.5	2.5	79.5	.....	2.5	3	Slight anisocytosis.	389	670	Water, clear....	58	...do..	...do.....	...do.....	Do.
44	.....	69	4,976,000	10,000	11	4.5	83	.5	1	0	Normal.....	473	816	.....do.....	58	...do..	...do.....	...do.....	Do.
49	.....	73	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
54	.....	69	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
57	.....	71	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
59	.....	78	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
69	.....	77	5,488,000	6,400	19	2	77	.....	2	4	Slight anisocytosis.	467	792	Clear.....	59	.....	.....	.....	
77	.....	78	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
80	.....	80	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
90	.....	83	5,696,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
104	.....	91	6,392,000	8,000	13	.....	87	.....	.....	0	Normal.....	.....	.....	Lipaemia.....	46	.....	.....	.....	
134	.....	90	5,680,000	7,000	10	2	86	.....	2	0	.....do.....	395	745	Lipaemia+++..	53	.....	.....	.....	
174	.....	99	6,424,000	7,400	5	5	89	.....	1	0	.....do.....	582	1,039	.....do.....	56	.....	.....	.....	

February 25, 1919.—Autopsy.—Dog is well nourished. No icterus. No excess of serous fluids. Heart and lungs normal. Stomach and intestines are negative. Pancreas and adrenals show nothing of importance. Kidneys are normal in gross and in sections. Spleen is normal in size and appearance. The pulp contains no pigment-holding phagocytes. Mesenteric lymph glands are normal. Bone marrow is mottled gray and pink. Microscopically it consists chiefly of fat with very little myeloid tissue. Liver is normal in size. The capsule is smooth. On cut section the lobules appear normal. Gall bladder is distended with 16 c. c. dark brown, clear bile. The bile ducts are normal. Microscopically the liver cells appear normal. No scarring. The bile ducts are unchanged.

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TABLE 35.

[20 mg. 2, 4, 6-trinitro-benzoic acid per kilo, in olive oil, intraperitoneally. One dose only.]

DOG 61.

Meat diet.

Day of experiment.	Time.	Food eaten daily.	Body weight.	Temperature (rectal).	Clinical symptoms.		Urine.					Feces.	Remarks.
					Character of mucous membranes.	Incoordination.	Color.	Albumin.	Fehling's test.	Bile pigment.	Webster's reaction.		
	A. M.	*Gms.*	*Kilos.*	°C.									
1	9.00	.....	11.8	.....	Normal...	None..	Amber, cloudy.....	None..	Negative	None..	.....	.....	Adult hound, male. Excellent condition.
	10.33	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	236 mg. trinitro-benzoic acid, in 30 c. c. olive oil, intraperitoneally.
	10.56	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	500 c. c. water by stomach tube.
	P. M.												
	12.15	.....	.....	.....	Normal...	None..	Purplish red.....	None..	Negative	None..	+++...	.....	Lively. Pulse 144, normal. No hemoglobin bands in urine.
	3.00	.....	.....	38	...do.....	...do...	.....do.....	...do...	+++....	...do...	++++.	Diarrhea..	Pulse 128, regular. Lively.
	4.30	360	.....	38.4	...do.....	...do...	Brilliant red.....	...do...	.....	...do...	+++...	.....	Pulse 160. Lively. Urine contains no hemoglobin.
2	.....	395	12.6	.....	Pale pink.	...do...	Orange, cloudy.....	...do...	Negative	...do...	++.....	None.....	Lively.
3–5	.....	400	.....	38.1	...do.....	...do...	Light brown, cloudy...	.....	.....	++...	Negative	Hard.....	Abdomen soft.
6–55	.....	395	13.4	.....	Normal...	...do...	Light brown.....	.....	.....	+.....	.....	.....do.....	Normal appearance.
56–79	.....	395	14.2	.....	...do.....	...do...	.....do.....	.....	.....	+.....	.....	Soft.....	Do.
80	.....	.....	14.8	.....	.....	.....	.....	.....	.....	.....	.....	.....	Experiment discontinued.

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Day of experiment.	Time.	Hb.	Red cells per c. mm.	White cells per c. mm.	Differential count						Nucleated reds.	Character of reds.	Blood volume.		Plasma.				Methb.	Clot.
					Small monos.	Large monos.	Pmn. n.	Pmn. eos.	Pmn. bas.	Tr.			Plasma.	Total.	Character.	Per cent.	Hemolysis.	Webster's reaction.		
	A. M.	Perct.			Perct.	Perct.	Perct.	Perct.	Perct.	Perct.			c. c.	c. c.						
1	9.00	93	8,144,000	12,600	15	2	62	19	.....	2	0	Normal.....	549	1,056	Amber, clear	52	None..	Negative	None..	Firm.
	P. M.																			
	12.15	80	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Water, clear.	.....	...do...	+.....	...do...	Do.
	2.15	81	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....do.....	54	...do...	+Slight.	...do...	Do.
	4.15	84	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....do.....	57	...do...	...do.....	...do...	Do.
2	.....	81	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	60	.....	.....	.....	.....
7	.....	91	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Lipaemia++	54	None..	+Slight.	None..	Do.
9	.....	90	7,360,000	10,200	24	4	65	3	2	2	0	Normal.....	654	1,189	Amber, clear	55	...do...	...do.....	...do..	Do.
19	.....	91	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
20	.....	94	6,728,000	12,700	16.5	2	74.5	.5	3	3.5	0	Slight anisocytosis.	670	1,218	Lipaemia +.	55	None..	Negative	None..	Do.
24	.....	80	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
31	.....	79	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Amber, clear	62	None..	Negative	None..	Do.
36	.....	90	6,256,000	14,000	23	1	72	1	.....	3	0	Normal.....	655	1,191	Water, clear.	55	...do...	...do.....	...do..	Do.
44	.....	85	6,152,000	12,600	19	3.5	73.5	.....	.....	4	2	.....do.....	691	1,256	.....do.....	55	...do...	...do.....	...do..	Do.
49	.....	83	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
54	.....	80	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
57	.....	78	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
62	.....	78	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
68	.....	79	5,728,000	12,800	4	11	79	6	.....	.....	0	Normal.....	733	1,202	Clear.....	61	.....	.....	.....	.....
70	.....	76	5,568,000	17,200	8	4.5	82	1.5	1.5	2.5	0	.....do.....	783	1,243	Slightly turbid.	63	.....	.....	.....	.....
80	.....	78	7,904,000	16,600	18	14	66.5	.....	.5	1	0	.....do.....	.....	.....	.....	.....	.....	.....	.....	.....

Repetition of foregoing experiment.

November 25, 1918.—Given intraperitoneally 280 mg. trinitro-benzoic acid (20 mg. per kilo body weight) in 30 c. c. olive oil.

November 26, 1918, to February 25, 1919.—Blood picture, clinical symptoms, and urine findings are in general similar to those tabulated in Table 35 and Chart 31.

February 26, 1919.—Dog weighs 14.2 kilos. Blood and urine are normal. Active and in excellent condition. Killed with chloroform.

Autopsy.—Oral mucous membrane and conjunctivae are intact and appear normal. No excess of serous fluids. Heart and lungs are negative. Stomach and intestines are normal. Spleen, kidneys, and mesenteric lymph glands are normal in gross and in sections. Liver is fatty. Capsule is smooth. On section the lobules are conspicuously outlined with opaque grayish-yellow centers and more translucent normal-appearing peripheries. Gall bladder is distended with 17 c. c. light brown clear bile. The bile ducts are normal. Microscopically the liver cells composing the central third of all the liver lobules are loaded with large and small fat droplets. The liver cells surrounding the portal spaces appear normal. The portal structures are unchanged. Bone marrow of femur is mottled gray and pink. Microscopically it consists chiefly of fat, with a moderate amount of myeloid tissue.

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TABLE 36.—*Extra-cellular blood destruction and phagocytosis causative factors of the anemia in T. N. T. poisoning in dogs.*

Type of experiment.	Whole blood.				Blood plasma.		Disintegrating reds per 1,000 red corpuscles.[1]						Urine.		Bladder bile.			Remarks.
	Color.	Hemoglobin per cent.		Methemoglobin.	Color.	Hemoglobin, methemoglobin or bile pigments.	Blood.	Spleen perfusate.	Liver perfusate.	Bone marrow perfusate.	Spleen smear.	Bone marrow smear.	Hemoglobin or methemoglobin.	Bile pigments.	Character.	Hemoglobin or methemoglobin.	Urobilin.	
		Initial.	Just before perfusing.															
Dog P-2, normal control.	Normal	.....	103	None.	Amber, clear.	None.	0	2	0	0	1	0	None.	Trace..	Normal	None.	None	Spleen pulp contains a few hemosiderin-holding phagocytes.
Dog P-3, normal control.	...do..	.....	93	...do..	Water, clear.	...do..	4	2	0	0	1	1	...do..	None..	...do..	...do..	...do.	Do.
Dog P-4, 100 mg. T. N. T. per kilo, per os. Organs perfused at end of 20 hours.	Chocolate brown.	108	107	Present.	Amber, clear.	...do..	3	6	43	42	7	4	...do..	...do..	...do..	...do..	...do.	Bone marrow contains a few hemosiderin-holding phagocytes.
Dog P-5, 50 mg. T. N. T. per kilo, per os on 2 days. Organs perfused 44 hours after first dose.	...do...	118	103	...do..	...do...	...do..	8	34	23	6	20	13	...do..	...do...	Dark brown, clear.	...do..	...do.	The endothelial Kupffer cells of the liver, the large mononuclear phagocytes of the spleen pulp and bone marrow contain engulfed red corpuscles and some coarsely granular hemosiderin.
Dog P-6, 50 mg. T. N. T. per kilo, per os on 4 days. Organs perfused 92 hours after first dose.	...do...	129	96	...do..	Light yellow, clear.	...do..	51	44	77	30	28	26	...do..	Increasing amounts	Very dark brown, clear.	...do..	...do.	The endothelial Kupffer cells of the liver are greatly swollen and are loaded with intact red cells and contain coarsely granular hemosiderin. The spleen pulp and bone marrow contain a tremendous number of phagocytes loaded with red corpuscles and some hemosiderin.

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Dog P-7, 50 mg. T. N. T. per kilo, per os on 5 days. Organs perfused 116 hours after first dose.	...do...	114	99	...do..	Amber, clear.	...do..	41	27	38	58	.....	37	..do..	..do...	..do..	....do.	...do.	The endothelial Kupffer cells of the liver are loaded with red corpuscles and contain hemosiderin. Spleen pulp and bone marrow contain numerous phagocytes loaded with red corpuscles and some hemosiderin.

[1] The hemoglobin content of the organ perfusates of the animals enumerated in this table is the same in each case when compared with the hemoglobin content of the diluted blood of the animal. If the hemoglobin content of the blood aspirated from the external jugular vein and diluted with gelatin-Locke's-citrate solution is considered 100 per cent, the spleen perfusate contained 60 per cent, the liver perfusate 40 per cent, the bone marrow perfusate 15 per cent.

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9. THE MECHANISM OF THE ANEMIA.

The perfusion experiments cited below were carried out to determine the part played by extra cellular blood destruction in the anemia following T. N. T. poisoning in dogs.

The methods described by Rous and Robertson (1917) in their publication on the normal fate of erythrocytes have been employed. The circulating blood was examined for disintegrating red cells. From the external jugular vein 5 c. c. of blood were aspirated into 30 c. c. of gelatin-Locke's-citrate solution. The animal was etherized and the liver, spleen, and bone marrow were excised one at a time and were perfused immediately with gelatin-Locke's citrate. The hemoglobin content of the organ perfusates and diluted blood was recorded. Portions of the perfusates and diluted blood were then slowly centrifuged in 15 c. c. tubes. When the mass of red cells was sedimented the shimmering, faintly pink, supernatant fluids were removed to other tubes and centrifuged at high speed. The slight sediment was mixed with a few drops of gelatin-Locke's solution and film preparations were made and stained with Wright's stain. Spleen and bone marrow smears were also made and stained with Wright's stain. The spleen, liver, and bone marrow were sectioned.

The examination for disintegrating red corpuscles in the blood and organ perfusate films and also in the spleen and bone marrow smears revealed the presence of an increased number of disintegrating red corpuscles in the dogs poisoned with T. N. T. The number seen in counting 1,000 red cells was recorded.

The cells are often small. Sometimes they are as large as and even larger than the normal red cell. Most of them are characterized by a translucent blisterlike elevation extending from a portion of the cell and having at times a somewhat irregular outline. The hemoglobin mass within these cells stains uniformly and deeper than the surrounding red corpuscles. (See Fig. 1.) Other cells were found in which the hemoglobin is apparently divided by a clear portion—fragmenting red cells of this type from the spleen of a normal rabbit are shown in a microphotograph in Rous and Robertson's article.

Table 36 contains the observations made on four dogs acutely poisoned with T. N. T. The two dogs used as control experiments were active and normal and in excellent condition. The blood withdrawn from the external jugular vein became chocolate brown in color a few hours after the administration of T. N. T. and contained large amounts of methemoglobin. The hemoglobin content diminished progressively after the first 20 hours. The blood plasma remained normal in color and contained no hemoglobin, methemoglobin, or bile pigments. The blood, organ perfusates, and smears made from the bone marrow and spleen showed an increased number of disintegrating red corpuscles. Hemolyzing red corpuscles or red corpuscle shadows were not encountered. The urine contained increasing amounts of bile pigments, but at no time hemoglobin or methemoglobin. The gall bladder bile was very dark. Undoubtedly it contained a greatly increased amount of bile pigments. Hemoglobin or methemoglobin were not present. Urobilin was found in the bile of Dog P-7. After the first 20 hours the spleen was slightly enlarged and contained numerous mononuclear phagocytes loaded with intact red corpuscles and some granular hemosiderin—some of the granules were as large as the original red corpuscles. The bone marrow contained many phagocytes loaded with red corpuscles and some hemosiderin. The Kupffer cells of the liver were greatly distended with engulfed red corpuscles and contained hemosiderin. The liver cells and bile ducts were normal.

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THE IN VITRO EFFECT OF T. N. T. AND SOME OF ITS DERIVATIVES ON THE RED CORPUSCLES AND HEMOGLOBIN OF THE DOG.

The following series of experiments was carried out in order to learn whether trinitrotoluene or its derivatives used in the animal experiments have any hemolytic action in vitro and also whether they are capable of changing oxyhemoglobin into methemoglobin. The effect of each chemical was determined on defibrinated blood, whole blood mixed with an equal quantity of 3.8 per cent sodium citrate solution and red corpuscles washed three times with gelatin-Locke's-citrate solution and finally suspended in gelatin-Locke's solution. The hemolytic tests were carried out in 15 c. c. centrifuge tubes which had previously been thoroughly washed in distilled water and rinsed with gelatin-Locke's solution. In one set of tubes 10 mg. of the chemical were added directly to 5 c. c. of the three blood combinations, and in another set 1 c. c. of an equimolecular solution in olive oil was employed. The tubes were inverted several times to assure thorough contact with the red corpuscles, and after intervals varying from 6 minutes to 2 hours at room temperature, or 20 minutes to 1 hour in a water bath at 37° C., the tubes were centrifugalized. The supernatant fluids were examined spectroscopically for oxyhemoglobin and methemoglobin. The sedimented red corpuscles were laked with distilled water and examined spectroscopically for methemoglobin.

None of the derivatives of trinitrotoluene studied cause any hemolysis in vitro. All of the derivatives with the exception of 2, 6-dinitroazoxytoluene change oxyhemoglobin into methemoglobin. Washed red corpuscles suspended in gelatin-Locke's solution are more reactive to the poisons than the red corpuscles of defibrinated blood or citrated blood.

Summary of the in vitro hemolytic tests.

Chemical tested.	Hemolysis.		Methemoglobin.	
	25° C.	37° C.	25° C.	37° C.
2, 4, 6-trinitrotoluene	None..	None..	+Within 2 hours.....	+ Within 20 minutes.
2, 6-dinitroparatoluidine	...do...	...do...	None within 2 hours..	+Within 1 hour.
6-nitro—2, 4-diaminotoluene	...do...	...do...	.....do.....	Do.
2, 6-dinitro—4-hydroxylaminotoluene[1]	...do...	...do...	+++Immediately....	+++Immediately.
2, 6-dinitroazoxytoluene	...do...	...do...	None.....	None.
2, 4, 6-trinitrobenzoic acid	...do...	...do...	None within 2 hours..	+Within 1 hour.

[1] The blood immediately becomes chocolate brown in color and contains methemoglobin.

It is obvious from the above table that trinitrotoluene causes no hemolysis in vitro when added either directly or dissolved in olive oil to defibrinated blood, citrated blood, or washed red blood corpuscles. However, it is absorbed by the red corpuscles and changes the oxyhemoglobin into methemoglobin within 20 minutes at 37 degrees centigrade.

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10. EXAMINATION OF T. N. T. WORKERS.

TABLE 37.

No. of worker.	Sex.	Age.	Time of exposure.	Hemoglobin.	R. B. C.	Color index.	W. B. C.	Differential count.						Nucleated R. B. C.	Character of R. B. C.
								S. M.	L. M.	P. M. N.	P. M. B.	P. M. E.	Trans.		
		Yrs.	*Days.*												
1	M.	39	10	91	3,736,000	1.21	8,200	43.5	0.5	56	0	0	0	1	Normal.
2	M.	23	15	85	4,288,000	1	7,600	40	7	52	0	0	1	0	Do.
3	F.	27	17	76	4,112,000	.93	8,800								
4	F.	18	22	101	4,616,000	1.09	9,000	14	34	51	0	0	1	0	
[1]5	M.	20	24	57	2,936,000	.96	13,000	49	7	42	0	2	0	0	Do.
6	F.	28	26	69	4,560,000	.76	6,000	27	22	45	0	3	3	1	Do.
7	F.	18	29	66	4,024,000	.80	9,000	34	1	61	2	0	2	0	Anisocytosis.
8	F.	19	29	74	4,464,000	.83									Normal.
[1]9	M.	50	30	70	4,544,000	.77	6,600	38	15	38	0	6	0	1	Do.
10	F.	23	30	76	5,120,000	.74	9,000	39	9	52	0	0	0	0	Do.
11	M.	21	30	72	5,200,000	.69	12,600	28	12	56	0	0	4	0	Do.
[1]12	M.	35	31	66	4,264,000	.78	7,000	20	24	54	0	0	2	0	Do.
13	F.	25	31	78	3,776,000	1.04	6,800	31	16.5	52	0	0	0	0	Slight poikilocytosis and anisocytosis.
14	F.	42	31	92	4,240,000	1.08	6,000	10	25	58	0	1	6	0	Slight anisocytosis.
15	M.	56	34	74	4,056,000	.91	10,800	41	8	51	0	0	0	0	Normal.
16	M.	19	37	75	4,128,000	.91	3,800	16	22	56	0	0.5	4.5	0	Do.
17	M.	49	41	83	3,592,000	1.15	8,800	10	29	59	0	0	2	0	Do.
18	F.	30	41	75	4,272,000	.88	8,000	25	5	69	0	0.5	0.5	1	Do.
			69	96	4,536,000	1.05	9,400	30	0	69	1	0	0	0	Poikilocytosis.
19	M.	44	42	66	3,864,000	.86	7,200	29	6.25	63.5	0	0	1	0	Normal.
20	F.	19	42	84	4,824,000	.87	8,800	41	5	54	0	0	1	0	Marked anisocytosis and poikilocytosis.
21	F.	28	44	65	3,224,000	1									Normal.
22	F.	20	44	77	4,464,000	.86	6,400	5.5	23.5	69	0	0.5	1.5	0	Slight anisocytosis.
23	F.	18	45	89	4,912,000	.91	10,200	18	20.5	58.5	0	1	2	0	Anisocytosis and poikilocytosis.
[1]24	M.	36	45	78	4,432,000	.87		11	28.5	56.5	0	0	3	0	Slight anisocytosis.
25	F.	21	47	76	4,344,000	.87	9,400	6	18	74	0	0	2	0	Slight poikilocytosis and anisocytosis.
26	F.	20	47	86	3,960,000	1.09									Normal.
27	F.	18	52	78	4,120,000	.95									Slight anisocytosis.
28	F.	19	52	88	5,152,000	.85	9,600	24	12	64	0	0	0	0	Slight poikilocytosis.
29	F.	18	52	85	5,008,000	.85	10,200	26	7	65	0	1	1	0	Normal.
30	F.	18	54	91	3,488,000	1.30	10,400	9	35	54	0	0	2	0	Do.
31	F.	30	54	66	4,118,000	.82									Do.
32	F.	27	54	74	4,120,000	.91									Do.
33	F.	21	56	78	4,808,000	.81	5,800	12	32	55	0	1	0	0	Do.
34	M.	56	60	71	4,544,000	.78	8,800	17.5	18.5	62.5	0	0	1	0	Poikilocytosis and anisocytosis.
[1]35	M.	27	60	70	4,408,000	.80	5,800	55	5	40	0	0	0	0	Normal.
36	F.	23	60	76	3,904,000	.97	5,000								
37	F.	22	60	65	4,048,000	.80	4,600	30	18	47	0	0	5	0	Normal.

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38	M.	.....	61	76	4,896,000	.77	10,600	.....	.....	.....	.....	.....	.....	.....
39	F.	42	61	66	3,432,000	.97	6,400	15	25	56	0	1	3	1
40	F.	19	61	73	3,840,000	.95	6,600	36	9	54	0	0	1	3
41	F.	17	62	79	5,440,000	.72	5,600	21	10	64	1	0	4	0
42	F.	25	63	65	4,304,000	.76	16,200	37	4	59	0	0	0	1
43	F.	22	66	72	4,000,000	.9	5,400	41	1	58	0	0	0	0
44	M.	38	67	88	4,624,000	.96	9,600	31	11	55	0	1	2	0
45	F.	18	67	87	4,824,000	.91	5,200	23	19	66	0	0	2	0
46	F.	19	69	73	4,984,000	.73	9,400	.....	.....	.....	.....	.....	.....	.....
47	F.	18	70	73	4,776,000	.77	.....	.....	.....	.....	.....	.....	.....	.....
48	M.	18	70	83	4,424,000	.94	11,600	40	12	48	0	0	0	0
49	M.	61	73	86	4,008,000	1.07	5,800	29	10	61	0	0	0	15
50	M.	19	73	80	4,216,000	.95	.....	.....	.....	.....	.....	.....	.....	.....
51	F.	22	74	64	4,104,000	.78	9,000	26	24	48	0	0	2	0
52	M.	33	80	66	3,992,000	.80	9,400	18	26	55	0	0	1	7
53	M.	19	86	84	3,360,000	1.25	7,000	30	3	65	1	0	1	0
54	F.	28	91	78	4,384,000	.88	5,400	38.5	2.5	58	0	0.5	0.5	0
			122	85	4,224,000	.....	5,400	56	4	40	0	0	0	0
55	M.	19	91	69	4,632,000	.74	13,000	22	9	72	1	2	2	2
56	F.	21	92	70	3,816,000	.92	5,600	40	3	57	0	0	0	0
57	M.	18	92	66	4,544,000	.73	5,600	43	11	45	0	0	1	0
58	M.	48	93	86	4,728,000	.92	7,000	33	13	51	0	0	3	0
59	M.	19	95	76	4,256,000	.89	5,600	30	12	57	0	0	1	0
60	M.	19	98	69	4,584,000	.75	8,200	39	5	56	0	0	0	0
61	M.	24	102	76	4,944,000	.86	9,600	23	2	75	0	0	0	0
62	M.	46	107	78	4,288,000	.91	7,400	23	9	67	0	0	1	0
63	F.	24	108	74	3,744,000	.99	8,000	8.5	25	54.5	1	5	6	0
			136	71	5,184,000	.68	8,000	47	1	52	0	0	0	0
64	F.	20	111	73	4,400,000	.83	.....	.....	.....	.....	.....	.....	.....	.....
65	F.	32	115	73	4,552,000	.80	5,800	4	38	58	0	0	0	0
66	M.	33	117	69	4,544,000	.76	9,400	35	29	36	0	0	0	0
67	F.	37	117	75	4,336,000	.86	11,200	23	20	57	0	0	0	0
68	M.	19	118	80	3,520,000	1.07	4,600	45	2	50	0	1	2	0
69	F.	22	119	84	3,824,000	1.1	.....	.....	.....	.....	.....	.....	.....	.....
70	F.	42	119	66	4,784,000	.69	13,600	45	3	50	2	0	0	0
71	M.	41	125	97	3,856,000	1.26	16,200	12.5	38	45	0	0	4.5	0
72	M.	18	128	82	4,168,000	.99	8,400	56	3	40	0	1	0	2
73	M.	70	129	73	4,104,000	.89	12,000	38	23	38	0	0	1	2
74	F.	25	135	70	4,352,000	.80	4,600	34	5	60	0	0	1	0
75	M.	19	136	67	4,376,000	.77	10,600	.....	.....	.....	.....	.....	.....	.....
76	F.	47	140	62	3,968,000	.77	7,600	12	27	58	0	0	3	0
77	M.	48	142	65	5,200,000	.63	.....	.....	.....	.....	.....	.....	.....	.....
78	F.	42	142	76	3,688,000	1.03	11,400	35.5	24	38.5	0	1	0.5	0.5
			171	64	2,880,000	1.10	7,000	54	2	43	0	0	1	0
79	M.	19	146	81	4,312,000	.94	6,600	39	7	52	0	0	2	0
80	F.	31	149	75	3,512,000	1.07	7,000	22	14	64	0	0	0	0
81	F.	32	150	103	3,880,000	1.3	14,000	35	13	48	2	0	2	0
82	M.	25	150	73	4,688,000	.77	7,600	56	0	44	0	0	0	0
83	M.	28	152	77	4,392,000	.87	11,000	7.5	29	58.5	0	0.5	4.5	16
84	F.	40	154	73	4,008,000	.90	11,200	42	13.5	44.5	0	0	0	6

38	Normal.
39	Slight anisocytosis.
40	Normal.
41	Do.
42	Do.
43	Do.
44	Do.
45	Do.
46	Do.
47	Do.
48	Poikilocytosis and slight anisocytosis.
49	Normal.
50	Poikilocytosis and anisocytosis.
51	Normal.
52	Do.
53	Marked anisocytosis.
54	Anisocytosis.
	Anisocytosis and poikilocytosis.
55	Slight poikilocytosis.
56	Anisocytosis.
57	Normal.
58	Do.
59	Do.
60	Do.
61	Do.
62	Do.
63	Do.
	Marked anisocytosis.
64	Normal.
65	Poikilocytosis and anisocytosis.
66	Normal.
67	Do.
68	Do.
69	Do.
70	Do.
71	Do.
72	Slight anisocytosis.
73	Normal.
74	Do.
75	Do.
76	Anisocytosis.
77	Normal.
78	Do.
	Do.
79	Slight anisocytosis.
80	Normal.
81	Poikilocytosis.
82	Normal.
83	Do.
84	Do.

[1] Negro.

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TABLE 37—Continued.

No. of worker.	Sex.	Age.	Time of exposure.	Hemoglobin.	R. B. C.	Color index.	W. B. C.	Differential count.						Nucleated R. B. C.	Character of R. B. C.
								S. M.	L. M.	P. M. N.	P. M. B.	P. M. E.	Trans.		
		Yrs.	*Days.*												
85	F.	18	154	68	4,448,000	.76	4,800	21	20	54	0	0	5	0	Marked anisocytosis.
86	F.	20	158	66	4,424,000	.75	10,000	27	3	70	0	0	0	0	Normal.
87	F.	23	160	79	5,032,000	.79									
88	M.	23	162	70	5,064,000	.70	8,400	39	2	58	0	0	1		Poikilocytosis.
89	M.	32	163	77	5,160,000	.75	6,000	45	15	39	0	0	1	0	Do.
90	F.	28	163	74	3,912,000	.95	11,600	32	10.5	55.5	0	0	0	0	Normal.
91	M.	35	165	85	4,440,000	.93	9,000	45	15	40	0	0	0	3	Anisocytosis.
92	F.	53	168	66	4,320,000	.76	9,000	38	4	57	0	1	0	0	Normal.
93	M.	32	169	76	4,440,000	.85	5,800	25	28	43	0	0	4	0	Do.
94	F.	26	174	75	4,256,000	.88	8,400	25	20	51	1	0	3	0	Do.
95	M.	24	177	63	4,720,000	.67								0	Do.
96	M.	19	182	83	4,224,000	.99	16,400	33	1	66	0	0	0		Slight anisocytosis.
97	F.	26	183	73	5,032,000	.73	9,400	20	12	65	0	0	3	0	Normal.
98	M.	24	185	86	3,424,000	1.26	7,800	43	5	61	0	0	1	0	Anisocytosis.
99	M.	21	187	73	4,648,000	.77	5,000	31	8	58	0	0	3	0	Normal.
100	M.	21	189	83	4,496,000	.90	10,800	24	19	54	0	3	0	0	Slight anisocytosis.
101	F.	23	190	72	4,448,000	.81	9,600	32	4	63	0	0	1	0	Normal.
102	M.	30	195	78	4,680,000	.83	6,000	31	8	60	0	0	1	0	Do.
103	F.	22	195	76	4,120,000	.93	4,000	15	22	56	0	0	1	0	Poikilocytosis and anisocytosis.
104	M.	27	210	77	3,360,000	1.15	7,600	17	27	51	0	0	7	0	Slight poikilocytosis and anisocytosis.
105	F.	37	280	69	4,480,000	.77	6,000	53	6	37	0	0	5	0	Anisocytosis.
106	M.	21	420	80	4,192,000	.98	10,600	18	1	81	0	2	2	0	Do.
107	M.	32	420	84	4,112,000	1.02	5,800	12	42	43	0	0	0	2	Slight anisocytosis.
108	M.	26	425	80	5,688,000	.70	8,400	47	5	46	0	0	2	0	Anisocytosis.
109	M.	50	545	72	4,072,000	.89	8,600	20	17	58	0	0	2	0	Normal.
110	M.	18	8	68	3,888,000	.87	16,400	4	40	51	0	0	5	0	Do.
111	F.	18	8	74	4,488,000	.82	5,200	25	17	56	0	2	3	0	Slight anisocytosis.
112	M.	44	21	78	4,856,000	.81	14,000	42	0	56	0	0	2	0	Normal.
113	M.	21	23	69	3,664,000	.94	10,400	31	6	62	0	0	2	0	Do.
114	M.	24	23	80	4,440,000	.90	9,000	31	25	44	0	0	1	0	Do.
115	M.	17	25	74	4,568,000	.71	10,200	37	1	61	0	0	0	0	Do.
116	F.	21	30	69	3,968,000	.87	11,200	35	11	53	0	0	1	0	Do.
117	F.	21	30	68	3,824,000	.89	7,200	35	5	60	0	0	0	0	Anisocytosis.
118	M.	42	30	92	3,960,000	1.16	10,800	11	28	53	0	1	7	0	Normal.
119	M.	26	30	63	4,104,000	.78	9,400	29	28	40	0	0	3	0	Do.
120	M.	45	44	70	4,240,000	.80	7,400	44	9	46	0	1	0	0	Slight anisocytosis.
121	M.	33	47	85	4,064,000	1.05	7,600	25	13	60	0	2	0	0	Normal.
			75	75	4,128,000	.90	8,000	26	0	74	0	0	0	7	Slight poikilocytosis.
122	M.	35	49	85	3,896,000	1.09	5,200	12	40	46	0	0	2	0	Normal.
123	M.	50	50	61	3,756,000	.81	6,400	39.5	5	54	0	0	1.5	0	Do.
			78	66	4,168,000	.71									Do.

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TABLE 37—Continued.

No. of worker.	Sex.	Age.	Time of exposure.	Hemoglobin.	R. B. C.	Color index.	W. B. C.	Differential count.						Nucleated R. B. C.	Character of R. B. C.
								S. M.	L. M.	P. M. N.	P. M. B.	P. M. E.	Trans.		
		Yrs.	*Days.*												
173	M.	23	192	65	4,352,000	.74	13,800	32	3	65	0	0	0	0	Normal.
174	M.	22	196	74	4,144,000	.89	6,800	40	20	38	0	0	2	0	Do.
175	M.	51	390	63	4,192,000	.75	7,000	31	3	62	1	0	3	0	Anisocytosis.
176	M.	23	14	85	4,768,000	.89	8,400	22	10	56	0	0	2	0	Normal.
177	M.	19	17	86	8,400,000	.80	7,200	38	3	59	0	0	0	0	Do.
178	M.	38	21	86	4,304,000	1	9,200								
179	M.	18	37	90	4,064,000	1.11	12,400	35	0	65	0	0	0	0	Do.
180	M.	18	39	90	4,640,000	.97	7,600	35	17	47	0	0	1	0	Anisocytosis and poikilocytosis.
181	M.	43	61	81	4,888,000	.83	7,800	25	11	56	0	0	8	0	Slight anisocytosis.
182	F.	25	69	86	5,208,000	.83	11,000	35	8	56	0	1	0	0	Anisocytosis.
183	M.	34	92	103	4,760,000	1.08	7,600	55	1	44	0	0	0	0	Normal.
184	M.	24	155	86	4,808,000	.90	7,400								
185	M.	34	171	90	3,912,000	1.15	4,800	47	1	52	0	0	0	0	Do.
186	M.	50	191	78	4,832,000	.80									
187	M.	65	200	79	4,536,000	.87	7,400	18	12	64	1	0	5	0	Anisocytosis and poikilocytosis.
188	F.	25	0	93	4,776,000	.98	9,200	26	17	55	0	0	2	0	Normal.
189	M.	33	0	84	4,776,000	.88	7,800	28	18	52	0	2	0	0	Do
190	F.	26	0	84	4,152,000	1.01	6,000	30.5	7	62.5	0	0	0	0	Do
191	M.	29	2	109	5,916,000	.92	7,800	35	10.5	52.5	0.5	1	0.5	0	Do.
192	M.	36	8	90	4,744,000	.95	6,600	40	1.5	58.5	0	0	0	0	Slight poikilocytosis.
193	F.	23	21	81	4,624,000	.88	8,200	37	1	62	0	0	0	0	Poikilocytosis.
194	F.	20	21	90	4,768 000	.95	9,400	25	5	69	0	0	1	1	Normal
195	M.	19	24	90	5,040,000	.90	6,200	13	51	33.5	0	0	2.5	0	Anisocytosis and poikilocytosis.
196	F.	21	26	86	4,440,000	.97	5,800	23	21	53	0	0	3	2	Normal.
197	F.	21	28	83	4,808,000	.86	5,800	25	30	42	0	0	3	0	Do.
198	M.	24	30	86	5,192,000	.83	9,600	25	7	68	0	0	0	0	Do.
199	F.	21	30	87	4,504,000	.91	13,000	14	27	56	0	0	3	0	Do.
200	F.	22	30	83	4,060,000	1.02	11,800	17	13	68.5	0.5	0	1	0	Do.
201	F.	22	36	82	4,344,000	.93									Anisocytosis.
202	F.	22	39	85	5,232,000	.80	7,600	7	37	52	0	0	4	0	Normal.
203	F.	22	45	80	4,288,000	.93									Do.
204	F.	23	47	86	4,408,000	.98	9,600	0	54	46	0	0	0	0	Anisocytosis.
205	F.	18	51	83	4,480,000	.90	5,400	30	13	56	0	0	1	0	Normal.
206	M.	33	54	89	4,264,000	1.05	8,400	28.5	4	67.5	0	0	0	0	Do.
207	F.	20	56	88	4,616,000	.95	6,200	17	8	74	0	0	1	0	Do.
208	F.	21	58	82	4,144,000	1.0	8,400	32	8	57	0	0	3	0	Slight anisocytosis.
209	F.	39	60	81	4,536,000	.90	9,400	27	7	66	0	0	0	0	Do.
210	M.	24	60	92	5,000,000	.92	8,000	36	15	49	0	0	0	1	Poikilocytosis.
211	M.	19	64	90	4,456,000	1.01									Anisocytosis.
212	M.	29	80	83	4,368,000	.95	9,600	26	5	68	0	0	1	0	Normal.
															Do.

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213	F.	19	86	101	4,712,000	1.07	6,400	8	40	48	0	0	4	0	Slight anisocytosis.
214	M.	20	90	86	4,528,000	.95	9,200	33	23	42	0	0	2	0	Normal.
215	M.	18	97	80	5,736,000	.61	7,200	54	0	46	0	0	0	0	Do.
216	M.	43	98	81	4,688,000	.86	8,200	22	10	67	0	0	1	0	Slight anisocytosis.
217	M.	21	106	84	4,592,000	.85	10,000	4	20	69	0	3	1	0	Anisocytosis.
218	F.	38	109	78	4,200,000	.93	9,400	24	6	68	0	1	0	1	Do.
219	M.	20	109	80	4,568,000	.88	9,200	28	4	68	0	0	0	0	Normal.
220	M.	21	138	90	4,560,000	.99	9,800	25	19	55	0	0	1	0	Do.
221	F.	24	138	75	4,024,000	.94	7,200	37	6.5	55.5	0	0.5	0.5	0	Do.
222	M.	28	144	91	4,808,000	.98	5,000	37	26	35	1	1	0	0	Do.
223	F.	18	150	98	4,192,000	1.17	8,200	36	0	72	0	0	2	0	Do.
224	F.	23	166	82	4,512,000	.90	10,000	20	5	75	0	0	0	0	Do.
225	F.	22	168	76	4,232,000	.86	.....	...	...	...	...	...	...	...	Anisocytosis.
226	M.	17	175	90	4,176,000	1.09	13,800	34	4	61	0	1	0	0	Normal.
227	M.	21	175	87	5,864,000	.74	.....	...	...	...	...	...	...	...	Do.
228	F.	18	184	90	4,496,000	1.0	6,200	38	17	45	0	0	0	0	Do.
229	F.	20	184	78	4,168,000	.94	6,000	30	0	68	0	0	2	0	Do.
230	M.	33	191	89	4,848,000	.92	10,400	30	13	56	0	1	0	0	Anisocytosis.
231	M.	58	197	86	4,372,000	.99	9,800	10	15	70	2	0	3	0	Slight anisocytosis.
332	M.	46	244	79	5,200,000	.76	9,600	26	11	56	0	5	2	0	Normal.
233	M.	37	275	83	4,712,000	.88	6,000	25	10	63	1	1	0	4	Do.
234	M.	43	360	82	5,552,000	.73	11,600	36	4	59	0	1	0	0	Anisocytosis and poikilocytosis.
235	M.	40	360	86	5,136,000	.84	6,480	42	24	31	0	0	3	0	Anisocytosis.
236	F.	28	394	77	4,032,000	.96	9,200	33	6	61	0	0	0	0	Normal.
237	M.	22	545	90	5,656,000	.79	17,800	31	4	65	0	0	0	0	Do.

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TABLE 38.

No. of worker.	Time of exposure.	State of nutrition.	Cyanosis.	Pallor.	Skin, Webster test.						Occupation.	Remarks.
					Hand.	Wrist.	Forearm.	Upper arm.	Neck.	Face.		
	Days.											
1	10	Good	Slight	None	++++		+		+		Finishing	
2	15	Fair	do	Present	++				+		Amatol recovery; amatol grinder	Complains of malaise.
3	17	Good	None	None							Finishing	"Lips turned blue at first."
4	22	do	do	do	+		Faint				do	No complaints.
5	24	Fair	do	do	+++		+				Loaded shell conveyor	Do.
6	26	Pale	do	Present	+		Faint	Faint			Scrapes loaded shells	"Lips turned blue at first."
7	29	Good	Slight	None	Faint						Finishing	No complaints.
8	29	do	do	do	+++		Faint				Finishing; blows out booster cavity.	Has severe headaches.
9	30	Fair	None	Present	++++	++		Faint			Works on loaded shell conveyor	
10	30	Good	Slight	do	+						Finishing	No complaints.
11	30	do	None	None	++++	+					do	Do.
12	31	Fair	do	do	+++	+					Works on loaded shell conveyor	Do.
13	31	Good	do	do	++++		+				Pouring T. N. T	Had marked dermatitis.
14	31	do	do	do	++						Finishing	No complaints.
15	34	do	Slight	do	+++						Works on loaded shell conveyor	Do.
16	37	do	None	do	++++		+++	Faint	++		do	Do.
17	41	Fair	Slight	Present	+++						Pouring T. N. T	Do.
18	41	Good	None	None	+						Finishing	Do.
	60	Fair	Slight	do							do	Do.
19	42	do	Marked	Marked							Finishing; melting T. N. T	Tires easily; severe constipation.
20	42	Good	None	None							Scraping loaded shells	No complaints.
21	44	Fair	Slight	Present	++			Faint			Pouring T. N. T	Do.
22	44	Good	None		++			do			Pouring T. N. T.; scraping loaded shells.	Do.
23	45	Excellent	do	None	++		+	do			Finishing	Do.
24	45	Good	do	do	+++++++	+++++	Faint				Works on loaded shell conveyor	Do.
25	47	do	do	do	++		do	Faint			Finishing	Do.
26	47	do	do	Slight	++			do			Pouring T. N. T	Feels dull and drowsy.
27	52	Excellent	do	None							do	No complaints.
28	52	Fair	do	do	++		+	Faint			Stirring melted T. N. T	Do.
29	52	Good	do	do							Works on loaded shell conveyor	Do.
30	54	Poor	do	Present	++++				+	Faint	Finishing	Do.
31	45	Good	do		++++						Pouring T. N. T	Do.
32	54	do	Slight	Present	++++	++					do	

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33	56	Excellent	None	None	++			−		−		Works on loaded shell conveyor	Do.
34	60	Fair	Slight	...do	++++			++		+		Pouring T. N. T	Do.
35	60	Good	None	...do	+++++	+++		−				Works on loaded shell conveyor	Do.
36	60	...do	...do	...do								Finishing	Do.
37	60	...do	...do	...do								...do	Do.
38	61	Fair	Present	...do	+ + + +							Amatol recovery; grinder	Complains of headache.
39	61	Good	None	Present	++			−		−		Finishing, but no pouring	No complaints.
40	61	Excellent	...do	None	+++	++		−		−	−	Finishing, putting glue on boosters.	Do.
41	62	...do	...do	...do								Finishing	Do.
42	63	Good	...do	...do	++++			+		−		Scraping loaded shells	Do.
43	66	...do	...do	...do								Pouring T. N. T	Dermatitis at first.
44	67	...do	Slight	...do	+ + + +			−		+		...do	No complaint.
45	67	...do	None	...do	+++			+	Faint			Finishing	Do.
46	69	...do	...do	...do	Faint			−		−		...do	Do.
47	70	...do	...do	...do	+++++			−		−		Stirring melted T. N. T. in shells	Do.
48	70	...do	...do	Present								Finishing	Do.
49	73	...do	...do	None	+			−		−		Amatol mix	Do.
50	73	...do	...do	...do								Amatol recovery	Do.
51	74	...do	...do	Slight	++++	++		++	Faint	+		Finishing	Do.
52	80	...do	...do	Present	+++++	+++		Faint	−	Faint	++	Cleaning out booster cavity	Do.
53	86	...do	...do	Slight	++++			+	−			Blows out booster cavity	Do.
54	91	Fair	...do	Present								Finishing	Complains of itching skin.
55	91	Good	...do	None	++++			++	Faint	++		...do	No complaints.
56	92	Fair	...do	...do	+++	+++		+				Finishing; blows out booster cavity.	Do.
57	92	Good	...do	...do	+++			+	Faint			Moves loaded shells	Do.
58	93	Fair	Slight	...do	+++			Faint	−			Finishing	Do.
59	95	Good	None	...do	+++	++		−	−	−	−	Finishing; occasionally melting T. N. T.	Do.
60	98	Fair	...do	Slight	++	++		+				Finishing	Do.
61	102	Poor	Slight	Present	+ + + +	+ +		−				...do	Dermatitis and cyanosis at first.
62	107	Good	...do	None	+++			−	−			...do	No complaints.
63	108	...do	None	...do	+			Faint	−			Stirring; sweeping floors	Do.
64	111	...do	...do	Slight								Finishing	Do.
65	115	...do	...do	None	+++			Faint	−			Pouring T. N. T.; stirring	Complains of headache.
66	117	...do	...do	...do	++	Faint		−	−	−	−	Line foreman	No complaints.
67	117	...do	...do	...do	Faint			−	−			Works all over line	Had dermatitis and lips turned blue at first.
68	118	Poor	Present	Present	++++	++		Faint	−			Finishing; blows out booster cavity.	No complaints.
69	119	...do	Slight	...do	++	++		...do				Extruding machine; cleaning out booster cavity.	Felt very sick at first.
70	119	Good	...do	...do	+	Slight		−				Stirring melted T. N. T. in shells	No complaints.
71	125	Fair	None	None	++			−	−	Faint		Line supervisor	Had mild dermatitis.
72	128	Good	...do	...do								All over line	No complaints.
73	129	...do	...do	...do								Attends to sweeping of floors	Do.
74	135	...do	...do	...do	+++++	++		−				Finishing	Lips turned blue at first.

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TABLE 38—Continued.

No. of worker.	Time of exposure.	State of nutrition.	Cyanosis.	Pallor.	Skin, Webster test.						Occupation.	Remarks.
					Hand.	Wrist.	Forearm.	Upper arm.	Neck.	Face.		
	Days.											
75	135	Poor	Slight	Present	+++++	++	Faint	−			Extruding machine 2 months, pouring melted T. N. T. rest of time.	Occasional headache; lips turned blue at first.
76	140	Good	do	None	+++++		do	−			Pouring melted T. N. T.	No complaints.
77	142	do	do	do	++		−				Amatol recovery	Lips turned blue at first.
78	142	Poor	do	Present								Often had cyanosis.
79	146	Good	None	None	+	−	−	−	−	−	Finishing	No complaints.
80	149	do	do	do	++++	++++	+++	−			Smoke mix and pouring; at present in empty shell room.	
81	150	do	do	Present							Scraping loaded shells	Do.
											Finishing	Had dermatitis and cyanosis at first; easily gets breathless on exertion.
82	150	do	Slight	Slight								
83	152	do	do	None	++++++	++++++	Faint	−	Faint	−	do	No complaints.
84	154	Poor	None	Present	++++	+++	−				4 months in smoke mixing; pouring T. N. T.	Do.
85	154	Good	do	do	+++	++	+				Finishing	Do.
86	158	do	Slight	None	+++++		−				First smoke mix, pouring room	Do.
87	160	do	None	do							Scraping loaded shells and stirring.	Do.
88	162	do	do	do	++++++		−				Finishing	Occasional headache.
89	163	do	do	do	++++	+	−				Line foreman; rarely handling shells.	Had dermatitis at first.
90	162	do	do	do							Works all over line as assistant supervisor.	No complaints.
91	165	do	do	do							Finishing	Do.
92	168	Fair	do	Present	++		−				Line supervisor	Do.
93	169	Good	do	None	++++		−		−	−	Pouring and stirring melted T. N. T.	Do.
											Line supervisor	Lips turn blue frequently; has dermatitis, on hands and forearms.
94	174	do	do	do	++++	++++	+++				Finishing	No complaints.
95	177	do	Marked	Present	+++		−				5 months foreman in drill house, then finishing.	Lips turn blue at times; feels dizzy and complains of dull abdominal pains, constipation, poor appetite.

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96	182	...do.....	None.....	None.....	++++.....	.....	Faint.....	.....	.....	.....	15 months in drill house, then finishing.	No complaints; lips turn blue at times.
97	183	Fair.....	...do.....	Slight.....	++++.....	.....	++.....	Faint.....	.....	.....	Works all over line.....	Lips turned blue at first; headaches.
98	185	Good.....	...do.....	None.....	.....	.....	.....	.....	.....	.....	Foreman in pouring room.....	No complaints.
99	187	...do.....	Slight.....	...do.....	+++.....	.....	Faint.....	.....	.....	.....	Assistant supervisor.....	Do.
100	189	...do.....	...do.....	...do.....	+++++.....	.....	+.....	.....	.....	.....	Finishing.....	Lips turned blue at first; has occasional headache and malaise.
101	190	...do.....	...do.....	Present...	+.....	.....	−.....	.....	.....	.....	Pouring melted T. N. T.; stirring.	Had vomiting and dermatitis.
102	195	Poor.....	None.....	...do.....	.....	.....	.....	.....	.....	.....	Line supervisor.....	No complaints.
103	195	Fair.....	...do.....	...do.....	++++.....	.....	−.....	.....	++.....	.....	Stirring melted T. N. T. in shells.	Do.
104	210	Good.....	...do.....	None.....	.....	.....	.....	.....	.....	.....	Line supervisor.....	Do.
105	280	...do.....	...do.....	...do.....	.....	.....	.....	.....	.....	.....	Finishing.....	Do.
106	420	...do.....	Slight.....	Present...	+++++++	.....	Faint.....	−	.....	.....	In drill house most of time, after that finishing.	Had suffered from T. N. T. poisoning 8 months ago.
107	420	...do.....	None.....	None.....	++	.....	...do.....	.....	.....	.....	Finishing.....	No complaints.
108	425	Poor.....	...do.....	...do.....	+++++	Faint.....	.....	.....	.....	.....	Scraping loaded shells.....	Do.
109	545	...do.....	...do.....	...do.....	+	−	.....	.....	.....	.....	Works all over line, most of time in empty shell room.	Do.
110	8	Good.....	Marked...	None.....	+++++	+++.....	++.....	Faint.	+.....	Faint...	Pouring melted T. N. T.....	Do.
111	8	...do.....	None.....	...do.....	+++++	.....	−	.....	.....	−.....	Finishing.....	Do.
112	21	Poor.....	Slight.....	...do.....	+++++	++.....	Faint.....	.....	.....	.....	Melting T. N. T.....	Occasional headaches.
113	23	Fair.....	None.....	...do.....	+++.....	Faint.....	−	.....	.....	.....	.....do.....	No complaints.
114	23	Poor.....	Marked...	Present...	++++.....	.....	+.....	Faint.....	.....	.....	Melting and pouring T. N. T.....	Headaches and constipation.
115	25	Fair.....	Slight.....	None.....	++++.....	++.....	Faint.....	.....	.....	.....	.....do.....	General malaise; insomnia.
116	30	Good.....	...do.....	...do.....	+++.....	++.....	−.....	−	.....	.....	Dipping and pouring melted T. N. T.	No complaints.
117	30	...do.....	None.....	...do.....	.....	.....	.....	.....	.....	.....	Melting and pouring T. N. T...	Do.
118	30	...do.....	...do.....	...do.....	+++++	.....	Faint.....	.....	−	−	.....do.....	Do.
119	30	...do.....	Slight.....	Slight.....	++++.....	+++.....	++.....	Faint.	.....	.....	Dipping and pouring melted T. N. T.	Headaches.
120	44	...do.....	...do.....	None.....	.....	.....	.....	.....	.....	.....	Melting and pouring T. N. T....	No complaints.
121	47	...do.....	...do.....	...do.....	.....	.....	.....	.....	.....	.....	.....do.....	Thoracic pain.
122	49	Poor.....	...do.....	...do.....	++++.....	.....	Faint.....	.....	+	.....	Melting T. N. T.....	No complaints.
123	50	Good.....	...do.....	Present...	++++.....	.....	...do.....	.....	+	.....	Melting and pouring T. N. T....	Do.
124	55	...do.....	...do.....	None.....	.....	.....	.....	.....	.....	.....	Melting T. N. T.....	Thoracic pain. Dermatitis of face.
125	58	Fair.....	...do.....	...do.....	++++++	.....	+++++	Faint.	.....	.....	Melting and pouring T. N. T.....	No complaints.
126	64	...do.....	Marked...	Present...	++++.....	++.....	+.....	...do.....	.....	.....	Melting and finishing.....	Headaches, constipation, malaise.
127	66	...do.....	None.....	...do.....	.....	.....	.....	.....	.....	.....	Melting and pouring T. N. T.....	No complaints.
128	72	Poor.....	Slight.....	...do.....	++++.....	+++.....	Faint.....	Faint	.....	.....	Dipping and pouring T. N. T....	Do.
129	74	Fair.....	...do.....	...do.....	++++++	++++...	++.....	−.....	+.....	−.....	Amatol mix, dipping and pouring.	Do.
130	77	...do.....	...do.....	None.....	+++++...	+++.....	+.....	−.....	Faint.	−.....	Melting and pouring T. N. T. ...	Do.

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TABLE 38—Continued.

No. of worker.	Time of exposure.	State of nutrition.	Cyanosis.	Pallor.	Skin, Webster test.						Occupation.	Remarks.
					Hand.	Wrist.	Forearm.	Upper arm.	Neck.	Face.		
75	*Days.* 135	Poor	Slight	Present	+++++	++	Faint	−			Extruding machine 2 months, pouring melted T. N. T. rest of time.	Occasional headache; lips turned blue at first.
76	140	Good	do	None	+++++		do	−			Pouring melted T. N. T.	No complaints.
77	142	do	do	do	++		−				Amatol recovery	Lips turned blue at first.
78	142	Poor	do	Present								Often had cyanosis.
79	146	Good	None	None	+	−	−	−	−	−	Finishing	No complaints.
80	149	do	do	do	++++	++++	+++	−			Smoke mix and pouring; at present in empty shell room.	
81	150	do	do	Present							Scraping loaded shells	Do.
82	150	do	Slight	Slight							Finishing	Had dermatitis and cyanosis at first; easily gets breathless on exertion.
83	152	do	do	None	++++++	++++++	Faint	−	Faint	−	do	No complaints.
84	154	Poor	None	Present	++++	+++	−				4 months in smoke mixing; pouring T. N. T.	Do.
85	154	Good	do	do	+++	++	+				Finishing	Do.
86	158	do	Slight	None	+++++		−				First smoke mix, pouring room	Do.
87	160	do	None	do							Scraping loaded shells and stirring.	Do.
88	162	do	do	do	++++++		−				Finishing	Occasional headache.
89	163	do	do	do	++++	+	−				Line foreman; rarely handling shells.	Had dermatitis at first.
90	162	do	do	do							Works all over line as assistant supervisor.	No complaints.
91	165	do	do	do							Finishing	Do.
92	168	Fair	do	Present	++		−				Line supervisor	Do.
93	169	Good	do	None	++++		−		−	−	Pouring and stirring melted T. N. T.	Do.
94	174	do	do	do	++++	++++	+++				Line supervisor	Lips turn blue frequently; has dermatitis, on hands and forearms.
95	177	do	Marked	Present	+++		−				Finishing	No complaints.
											5 months foreman in drill house, then finishing.	Lips turn blue at times; feels dizzy and complains of dull abdominal pains, constipation, poor appetite.

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96	182	...do	None	None	++++		Faint				15 months in drill house, then finishing.	No complaints; lips turn blue at times.
97	183	Fair	...do	Slight	++++		++	Faint			Works all over line	Lips turned blue at first; headaches.
98	185	Good	...do	None								No complaints.
99	187	...do	Slight	...do	+++		Faint				Foreman in pouring room	Do.
100	189	...do	...do	...do	+++++		+				Assistant supervisor	Lips turned blue at first; has occasional headache and malaise.
											Finishing	
101	190	...do	...do	Present	+		−				Pouring melted T. N. T.; stirring	Had vomiting and dermatitis.
102	195	Poor	None	...do							Line supervisor	No complaints.
103	195	Fair	...do	...do	++++		−		+		Stirring melted T. N. T. in shells	Do.
104	210	Good	...do	None							Line supervisor	Do.
105	280	...do	...do	...do							Finishing	Do.
106	420	...do	Slight	Present	++++++		Faint	−			In drill house most of time, after that finishing	Had suffered from T. N. T. poisoning 8 months ago.
107	420	...do	None	None	++		...do				Finishing	No complaints.
108	425	Poor	...do	...do	+++++	Faint					Scraping loaded shells	Do.
109	545	...do	...do	...do	+	−					Works all over line, most of time in empty shell room	Do.
110	8	Good	Marked	None	+++++	+++	++	Faint	+	Faint	Pouring melted T. N. T	Do.
111	8	...do	None	...do	+++++		−		−		Finishing	Do.
112	21	Poor	Slight	...do	+++	++	Faint				Melting T. N. T	Occasional headaches.
113	23	Fair	None	...do	+++	Faint	−				...do	No complaints.
114	23	Poor	Marked	Present	++++		+	Faint			Melting and pouring T. N. T	Headaches and constipation.
115	25	Fair	Slight	None	++++	++	Faint				...do	General malaise; insomnia.
116	30	Good	...do	...do	+++	++	−	−			Dipping and pouring melted T. N. T.	No complaints.
117	30	...do	None	...do							Melting and pouring T. N. T	Do.
118	30	...do	...do	...do	+++		Faint		−	−	...do	Do.
119	30	...do	Slight	Slight	++++	+++	++	Faint			Dipping and pouring melted T. N. T.	Headaches.
120	44	...do	...do	None							Melting and pouring T. N. T	No complaints.
121	47	...do	...do	...do							...do	Thoracic pain.
122	49	Poor	...do	...do	+++		Faint		+		Melting T. N. T	No complaints.
123	50	Good	...do	Present	++++		...do		+		Melting and pouring T. N. T	Do.
124	55	...do	...do	None							Melting T. N. T	Thoracic pain. Dermatitis of face.
125	58	Fair	...do	...do	++++++		+++++	Faint			Melting and pouring T. N. T	No complaints.
126	64	...do	Marked	Present	++++	++	+	...do			Melting and finishing	Headaches, constipation, malaise.
127	66	...do	None	...do							Melting and pouring T. N. T	No complaints.
128	72	Poor	Slight	...do	++++	+++	Faint	Faint			Dipping and pouring T. N. T	Do.
129	74	Fair	...do	...do	++++++	++++	++	−	+	−	Amatol mix, dipping and pouring	Do.
130	77	...do	...do	None	+++++	+++	+	−	Faint	−	Melting and pouring T. N. T	Do.

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TABLE 37—Continued.

No. of worker.	Sex.	Age.	Time of exposure.	Hemoglobin.	R. B. C.	Color index.	W. B. C.	Differential count.						Nucleated R. B. C.	Character of R. B. C.
								S. M.	L. M.	P. M. N.	P. M. B.	P. M. E.	Trans.		
		Yrs.	*Days.*												
173	M.	23	192	65	4,352,000	.74	13,800	32	3	65	0	0	0	0	Normal.
174	M.	22	196	74	4,144,000	.89	6,800	40	20	38	0	0	2	0	Do.
175	M.	51	390	63	4,192,000	.75	7,000	31	3	62	1	0	3	0	Anisocytosis.
176	M.	23	14	85	4,768,000	.89	8,400	22	10	56	0	0	2	0	Normal.
177	M.	19	17	86	8,400,000	.80	7,200	38	3	59	0	0	0	0	Do.
178	M.	38	21	86	4,304,000	1	9,200								
179	M.	18	37	90	4,064,000	1.11	12,400	35	0	65	0	0	0	0	Do.
180	M.	18	39	90	4,640,000	.97	7,600	35	17	47	0	0	1	0	Anisocytosis and poikilocytosis.
181	M.	43	61	81	4,888,000	.83	7,800	25	11	56	0	0	8	0	Slight anisocytosis.
182	F.	25	69	86	5,208,000	.83	11,000	35	8	56	0	1	0	0	Anisocytosis.
183	M.	34	92	103	4,760,000	1.08	7,600	55	1	44	0	0	0	0	Normal.
184	M.	24	155	86	4,808,000	.90	7,400								
185	M.	34	171	90	3,912,000	1.15	4,800	47	1	52	0	0	0	0	Do.
186	M.	50	191	78	4,832,000	.80									
187	M.	65	200	79	4,536,000	.87	7,400	18	12	64	1	0	5	0	Anisocytosis and poikilocytosis.
188	F.	25	0	93	4,776,000	.98	9,200	26	17	55	0	0	2	0	Normal.
189	M.	33	0	84	4,776,000	.88	7,800	28	18	52	0	2	0	0	Do
190	F.	26	0	84	4,152,000	1.01	6,000	30.5	7	62.5	0	0	0	0	Do
191	M.	29	2	109	5,916,000	.92	7,800	35	10.5	52.5	0.5	1	0.5	0	Do.
192	M.	36	8	90	4,744,000	.95	6,600	40	1.5	58.5	0	0	0	0	Slight poikilocytosis.
193	F.	23	21	81	4,624,000	.88	8,200	37	1	62	0	0	0	0	Poikilocytosis.
194	F.	20	21	90	4,768,000	.95	9,400	25	5	69	0	0	1	1	Normal
195	M.	19	24	90	5,040,000	.90	6,200	13	51	33.5	0	0	2.5	0	Anisocytosis and poikilocytosis.
196	F.	21	26	86	4,440,000	.97	5,800	23	21	53	0	0	3	2	Normal.
197	F.	21	28	83	4,808,000	.86	5,800	25	30	42	0	0	3	0	Do.
198	M.	24	30	86	5,192,000	.83	9,600	25	7	68	0	0	0	0	Do.
199	F.	21	30	87	4,504,000	.91	13,000	14	27	56	0	0	3	0	Do.
200	F.	22	30	83	4,060,000	1.02	11,800	17	13	68.5	0.5	0	1	0	Anisocytosis.
201	F.	22	36	82	4,344,000	.93									
202	F.	22	39	85	5,232,000	.80	7,600	7	37	52	0	0	4	0	Normal.
203	F.	22	45	80	4,288,000	.93									Do.
204	F.	23	47	86	4,408,000	.98	9,600	0	54	46	0	0	0	0	Anisocytosis.
205	F.	18	51	83	4,480,000	.90	5,400	30	13	56	0	0	1	0	Normal.
206	M.	33	54	89	4,264,000	1.05	8,400	28.5	4	67.5	0	0	0	0	Do.
207	F.	20	56	88	4,616,000	.95	6,200	17	8	74	0	0	1	0	Do.
208	F.	21	58	82	4,144,000	1.0	8,400	32	8	57	0	0	3	0	Slight anisocytosis.
209	F.	39	60	81	4,536,000	.90	9,400	27	7	66	0	0	0	0	Do.
210	M.	24	60	92	5,000,000	.92	8,000	36	15	49	0	0	0	0	Poikilocytosis.
211	M.	19	64	90	4,456,000	1.01									Anisocytosis.
212	M.	29	80	83	4,368,000	.95	9,600	26	5	68	0	0	1	0	Normal.
															Do.

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213	F.	19	86	101	4,712,000	1.07	6,400	8	40	48	0	0	4	0	Slight anisocytosis.
214	M.	20	90	86	4,528,000	.95	9,200	33	23	42	0	0	2	0	Normal.
215	M.	18	97	80	5,736,000	.61	7,200	54	0	46	0	0	0	0	Do.
216	M.	43	98	81	4,838,000	.86	8,200	22	10	67	0	0	1	0	Slight anisocytosis.
217	M.	21	106	84	4,592,000	.85	10,000	4	20	69	0	3	1	0	Anisocytosis.
218	F.	38	109	78	4,200,000	.93	9,400	24	6	68	0	1	0	1	Do.
219	M.	20	109	80	4,568,000	.88	9,200	28	4	68	0	0	0	0	Normal.
220	M.	21	133	90	4,560,000	.99	9,800	25	19	55	0	0	1	0	Do.
221	F.	24	138	75	4,024,000	.94	7,200	37	6.5	55.5	0	0.5	0.5	0	Do.
222	M.	28	144	91	4,808,000	.98	5,000	37	26	35	1	0	0	0	Do.
223	F.	18	150	98	4,192,000	1.17	8,200	36	0	72	0	0	2	0	Do.
224	F.	23	166	82	4,512,000	.90	10,000	20	5	75	0	0	0	0	Do.
225	F.	22	168	76	4,232,000	.86	.....	.....	.....	.....	.....	.....	.....	.....	Anisocytosis.
226	M.	17	175	90	4,176,000	1.09	13,800	34	4	61	0	1	0	0	Normal.
227	M.	21	175	87	5,864,000	.74	.....	.....	.....	.....	.....	.....	.....	.....	Do.
228	F.	18	184	90	4,496,000	1.0	6,200	38	17	45	0	0	0	0	Do.
229	F.	20	184	78	4,168,000	.94	6,000	30	0	68	0	0	2	0	Do.
230	M.	33	191	89	4,848,000	.92	10,400	30	13	56	0	0	0	0	Anisocytosis.
231	M.	58	197	86	4,372,000	.99	9,800	10	15	70	2	0	3	0	Slight anisocytosis.
232	M.	46	244	79	5,200,000	.76	9,000	26	11	56	0	5	2	0	Normal.
233	M.	37	275	82	4,712,000	.88	6,000	25	10	63	1	0	0	4	Do.
234	M.	43	300	82	5,552,000	.73	11,600	36	4	59	0	1	0	0	Anisocytosis and poikilocytosis.
235	M.	40	360	86	5,136,000	.84	6,480	42	24	31	0	0	3	0	Anisocytosis.
236	F.	28	394	77	4,032,000	.96	9,200	33	6	61	0	0	0	0	Normal.
237	M.	22	515	90	5,656,000	.79	17,800	31	4	65	0	0	0	0	Do.

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TABLE 38.

No. of worker.	Time of exposure.	State of nutrition.	Cyanosis.	Pallor.	Skin, Webster test.						Occupation.	Remarks.
					Hand.	Wrist.	Forearm.	Upper arm.	Neck.	Face.		
	Days.											
1	10	Good	Slight	None	++++		+		+		Finishing	
2	15	Fair	do	Present	++				+		Amatol recovery; amatol grinder	Complains of malaise.
3	17	Good	None	None							Finishing	"Lips turned blue at first."
4	22	do	do	do	+		Faint	−			do	No complaints.
5	24	Fair	do	do	+++		+	−			Loaded shell conveyor	Do.
6	26	Pale	do	Present	+		Faint	Faint			Scrapes loaded shells	"Lips turned blue at first."
7	29	Good	Slight	None	Faint		−	−			Finishing	No complaints.
8	29	do	do	do	+++		Faint				Finishing; blows out booster cavity	Has severe headaches.
9	30	Fair	None	Present	++++	++		Faint			Works on loaded shell conveyor	
10	30	Good	Slight	do	+		−				Finishing	No complaints.
11	30	do	None	None	++++	+	−	−			do	Do.
12	31	Fair	do	do	+++	+	−				Works on loaded shell conveyor	Do.
13	31	Good	do	do	++++		+	−			Pouring T. N. T	Had marked dermatitis.
14	31	do	do	do	++			−			Finishing	No complaints.
15	34	do	Slight	do	+++		−		−	−	Works on loaded shell conveyor	Do.
16	37	do	None	do	++++		+++	Faint	++		do	Do.
17	41	Fair	Slight	Present	+++			−			Pouring T. N. T	Do.
18	41	Good	None	None	+		−				Finishing	Do.
19	42	do	Marked	Marked							do	Do.
20	42	Good	None	None							Finishing; melting T. N. T	Tires easily; severe constipation.
21	44	Fair	Slight	Present	++			Faint			Scraping loaded shells	No complaints.
22	44	Good	None		++			do			Pouring T. N. T	Do.
23	45	Excellent	do	None	++		+	do			Pouring T. N. T.; scraping loaded shells	Do.
24	45	Good	do	do	+++++	++++	Faint				Finishing	Do.
25	47	do	do	do	++		do	Faint			Works on loaded shell conveyor	Do.
26	47	do	do	Slight	++			do			Finishing	Do.
27	52	Excellent	do	None							Pouring T. N. T	Feels dull and drowsy.
28	52	Fair	do	do	++		+	Faint			do	No complaints.
29	52	Good	do	do							Stirring melted T. N. T	Do.
30	54	Poor	do	Present	++++		−	−	+	Faint	Works on loaded shell conveyor	Do.
31	45	Good	do		++++		−	−	+	−	Finishing	Do.
32	54	do	Slight	Present	++++	++	−	−	−	−	Pouring T. N. T	Do.
											do	Do.

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33	56	Excellent	None	None	++		−		−	−	Works on loaded shell conveyor		Do.
34	60	Fair	Slight	do	++++						Pouring T. N. T		Do.
35	60	Good	None	do	+++++		++		+		Works on loaded shell conveyor		Do.
36	60	do	do	do		+++	−				Finishing		Do.
37	60	do	do	do							do		Do.
38	61	Fair	Present	do	+						Amatol recovery; grinder		Complains of headache.
39	61	Good	None	Present	+		−				Finishing, but no pouring		No complaints.
40	61	Excellent	do	None	+++	++	−		−	−	Finishing, putting glue on boosters.		Do.
41	62	do	do	do							Finishing		Do.
42	63	Good	do	do	++++						Scraping loaded shells		Do.
43	66	do	do	do			+		−		Pouring T. N. T		Dermatitis at first.
44	67	do	Slight	do	+++++						do		No complaint.
45	67	do	None	do	+++		−		+		Finishing		Do.
46	69	do	do	do	Faint		+	Faint			do		Do.
47	70	do	do	do	+++++		−		−		Stirring melted T. N. T. in shells		Do.
48	70	do	do	Present			−		−		Finishing		Do.
49	73	do	do	None	+						Amatol mix		Do.
50	73	do	do	do			−				Amatol recovery		Do.
51	74	do	do	Slight	+++++	++	++	Faint	+	−	Finishing		Do.
52	80	do	do	Present	+++++	++++	Faint		Faint	++	Cleaning out booster cavity		Do.
53	86	do	do	Slight	+++++		+		−		Blows out booster cavity		Do.
54	91	Fair	do	Present							Finishing		Do.
55	91	Good	do	None	++++		++	Faint	++		do		Complains of itching skin.
56	92	Fair	do	do	+++	+++	+				Finishing; blows out booster cavity.		No complaints.
57	92	Good	do	do	+++		+	Faint			Moves loaded shells		Do.
58	93	Fair	Slight	do	+++++		Faint				Finishing		Do.
59	95	Good	None	do	+++	++	−		−	−	Finishing; occasionally melting T. N. T.		Do.
60	98	Fair	do	Slight	++	++	+				Finishing		Do.
61	102	Poor	Slight	Present	+++++	+++	−				do		Dermatitis and cyanosis at first.
62	107	Good	do	None	+++		−				do		No complaints.
63	108	do	None	do	+			Faint	−		Stirring; sweeping floors		Do.
64	111	do	do	Slight							Finishing		Do.
65	115	do	do	None	+++			Faint	−		Pouring T. N. T.; stirring		Complains of headache.
66	117	do	do	do	++	Faint	−		−	−	Line foreman		No complaints.
67	117	do	do	do	Faint		−		−		Works all over line		Had dermatitis and lips turned blue at first.
68	118	Poor	Present	Present	++++	++		Faint	−		Finishing; blows out booster cavity.		No complaints.
69	119	do	Slight	do	++	++	do				Extruding machine; cleaning out booster cavity.		Felt very sick at first.
70	119	Good	do	do	+	Slight	−				Stirring melted T. N. T. in shells		No complaints.
71	125	Fair	None	None	++		−		−	Faint	Line supervisor		Had mild dermatitis.
72	128	Good	do	do							All over line		No complaints.
73	129	do	do	do	+++++	++	−				Attends to sweeping of floors		Do.
74	135	do	do	do							Finishing		Lips turned blue at first.

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TABLE 38—Continued.

No. of worker.	Time of exposure.	State of nutrition.	Cyanosis.	Pallor.	Skin, Webster test.						Occupation.	Remarks.
					Hand.	Wrist.	Forearm.	Upper arm.	Neck.	Face.		
	Days.											
75	135	Poor	Slight	Present	+++++	++	Faint	−			Extruding machine 2 months, pouring melted T. N. T. rest of time.	Occasional headache; lips turned blue at first.
76	140	Good	do	None	+++++		do	−			Pouring melted T. N. T.	No complaints.
77	142	do	do	do	++		−				Amatol recovery	Lips turned blue at first.
78	142	Poor	do	Present							Finishing	Often had cyanosis.
79	146	Good	None	None	+	−	−	−	−	−	Smoke mix and pouring; at present in empty shell room.	No complaints.
80	149	do	do	do	++++	++++	+++	−			Scraping loaded shells	Do.
81	150	do	do	Present							Finishing	Had dermatitis and cyanosis at first; easily gets breathless on exertion.
82	150	do	Slight	Slight								
83	152	do	do	None	++++++	++++++	Faint	−	Faint	−	do	No complaints.
84	154	Poor	None	Present	++++	+++	−				4 months in smoke mixing; pouring T. N. T.	Do.
85	154	Good	do	do	+++	++	+				Finishing	Do.
86	158	do	Slight	None	+++++		−				First smoke mix, pouring room	Do.
87	160	do	None	do							Scraping loaded shells and stirring.	Do.
88	162	do	do	do	++++++		−				Finishing	Occasional headache.
89	163	do	do	do	++++	+	−				Line foreman; rarely handling shells.	Had dermatitis at first.
90	162	do	do	do							Works all over line as assistant supervisor.	No complaints.
91	165	do	do	do	++		−				Finishing	Do.
92	168	Fair	do	Present							Line supervisor	Do.
93	169	Good	do	None	++++		−		−	−	Pouring and stirring melted T. N. T.	Do.
94	174	do	do	do	++++	++++	+++				Line supervisor	Lips turn blue frequently; has dermatitis, on hands and forearms.
95	177	do	Marked	Present	+++		−				Finishing	No complaints.
											5 months foreman in drill house, then finishing.	Lips turn blue at times; feels dizzy and complains of dull abdominal pains, constipation, poor appetite.

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96	182	...do.....	None.....	None.....	++++.....	.....	Faint.....	.....	.....	.....	15 months in drill house, then finishing.	No complaints; lips turn blue at times.
97	183	Fair.....	...do.....	Slight.....	++++.....	.....	++.....	Faint..	.....	.....	Works all over line.....	Lips turned blue at first; headaches.
98	185	Good.....	...do.....	None.....	.....	.....	.....	.....	.....	.....	Foreman in pouring room.....	No complaints.
99	187	...do.....	Slight.....	...do.....	+++.....	.....	Faint.....	.....	.....	.....	Assistant supervisor.....	Do.
100	189	...do.....	...do.....	...do.....	+++++..	.....	+.....	.....	.....	.....	Finishing.....	Lips turned blue at first; has occasional headache and malaise.
101	190	...do.....	...do.....	Present...	+.....	.....	−.....	.....	.....	.....	Pouring melted T. N. T.; stirring.	Had vomiting and dermatitis.
102	195	Poor.....	None.....	...do.....	.....	.....	.....	.....	.....	.....	Line supervisor.....	No complaints.
103	195	Fair.....	...do.....	...do.....	++++.....	.....	−.....	.....	++.....	.....	Stirring melted T. N. T. in shells.	Do.
104	210	Good.....	...do.....	None.....	.....	.....	.....	.....	.....	.....	Line supervisor.....	Do.
105	280	...do.....	...do.....	...do.....	.....	.....	.....	.....	.....	.....	Finishing.....	Do.
106	420	...do.....	Slight.....	Present...	++++++	.....	Faint.....	−.....	.....	.....	In drill house most of time, after that finishing.	Had suffered from T. N. T. poisoning 8 months ago.
107	420	...do.....	None.....	None.....	++.....	.....	...do.....	.....	.....	.....	Finishing.....	No complaints.
108	425	Poor.....	...do.....	...do.....	+++++...	Faint..	.....	.....	.....	.....	Scraping loaded shells.....	Do.
109	545	...do.....	...do.....	...do.....	+.....	−.....	.....	.....	.....	.....	Works all over line, most of time in empty shell room.	Do.
110	8	Good.....	Marked...	None.....	+++++...	+++.....	++.....	Faint.	+.....	Faint...	Pouring melted T. N. T.....	Do.
111	8	...do.....	None.....	...do.....	+++++...	.....	−.....	.....	.....	−.....	Finishing.....	Occasional headaches.
112	21	Poor.....	Slight.....	...do.....	++++.....	++.....	Faint.....	.....	.....	.....	Melting T. N. T.....	No complaints.
113	23	Fair.....	None.....	...do.....	+++.....	Faint....	−.....	.....	.....	.....	....do.....	Headaches and constipation.
114	23	Poor.....	Marked...	Present...	++++.....	.....	+.....	Faint.	.....	.....	Melting and pouring T. N. T.....	General malaise; insomnia.
115	25	Fair.....	Slight.....	None.....	++++.....	++.....	Faint.....	.....	.....	.....	....do.....	No complaints.
116	30	Good.....	...do.....	...do.....	+++.....	++.....	−.....	−.....	.....	.....	Dipping and pouring melted T. N. T.	Do.
117	30	...do.....	None.....	...do.....	.....	.....	.....	.....	.....	.....	Melting and pouring T. N. T...	Do.
118	30	...do.....	...do.....	...do.....	++++.....	.....	Faint....	−.....	−.....	−.....	....do.....	Headaches.
119	30	...do.....	Slight.....	Slight.....	++++.....	+++.....	++.....	Faint.	.....	.....	Dipping and pouring melted T. N. T.	No complaints.
120	44	...do.....	...do.....	None.....	.....	.....	.....	.....	.....	.....	Melting and pouring T. N. T....	Thoracic pain.
121	47	...do.....	...do.....	...do.....	.....	.....	.....	.....	.....	.....	....do.....	No complaints.
122	49	Poor.....	...do.....	...do.....	++++.....	.....	Faint.....	.....	+.....	.....	Melting T. N. T.....	Do.
123	50	Good.....	...do.....	Present...	++++.....	.....	...do.....	.....	+.....	.....	Melting and pouring T. N. T....	Thoracic pain. Dermatitis of face.
124	55	...do.....	...do.....	None.....	.....	.....	.....	.....	.....	.....	Melting T. N. T.....	No complaints.
125	58	Fair.....	...do.....	...do.....	++++++.	.....	+++++	Faint..	.....	.....	Melting and pouring T. N. T.....	Headaches, constipation, malaise.
126	64	...do.....	Marked...	Present...	++++.....	++.....	+.....	...do..	.....	.....	Melting and finishing.....	No complaints.
127	66	...do.....	None.....	...do.....	.....	.....	.....	.....	.....	.....	Melting and pouring T. N. T.....	Do.
128	72	Poor.....	Slight.....	...do.....	++++.....	+++.....	Faint.....	Faint.	.....	.....	Dipping and pouring T. N. T....	Do.
129	74	Fair.....	...do.....	...do.....	++++++.	++++..	++.....	−.....	+.....	−.....	Amatol mix, dipping and pouring.	Do.
130	77	...do.....	...do.....	None.....	+++++...	+++.....	+.....	−.....	Faint.	−.....	Melting and pouring T. N. T. ...	Do.

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TABLE 38—Continued.

No. of worker.	Time of exposure.	State of nutrition.	Cyanosis.	Pallor.	Skin, Webster test.						Occupation.	Remarks.
					Hand.	Wrist.	Forearm.	Upper arm.	Neck.	Face.		
	Days.											
131	78	Fair	Marked	Present							Melting and pouring T. N. T	Slight headache.
132	80	Good	Slight	None							do	No complaints.
133	82	do	None	do							Dipping and pouring T. N. T	Do.
134	85	do	do	do	+++		Faint	−			Amatol mix, then melting and pouring for 36 days.	Do.
135	85	do	do	do							Melting and pouring T. N. T	Do.
136	90	do	Slight	do	+++		++	Faint	+		Amatol mix, then melting and pouring for 60 days.	Do.
137	91	do	Marked	do	++++	+++	++	do			Melting T. N. T	Had dermatitis at first.
138	91	do	None	do	+		−				Amatol mix	Occasional headaches.
139	92	do	do	Present	++++		Faint		++		Melting T. N. T	Lost appetite.
140	94	Poor	Slight	Slight	++++	++++	+	Faint	Faint	Faint	First 60 days melting and pouring, then sweeping floors.	No complaints.
141	94	Fair	Present	Present	++++	++++	++	do	+	do	Melting and pouring T. N. T	Do.
142	95	Good	Slight	do	++++	+++	+	−	+	−	do	Do.
143	97	do	None	Slight	++++	++	−	−	Faint	−	Dipping and pouring T. N. T	Do.
144	98	do	Faint	None	++	++	−	−	do	Faint	Melting, pouring, etc	Do.
145	99	do	Slight	do	++++		++	Faint			Melting and pouring for last 30 days; previously on extruding machine.	Do.
146	105	Fair	None	Present							Melting, pouring, dipping, etc., for last 14 days; previously amatol mix.	Do.
	133	do	Marked	do							do	General malaise, losing appetite, severe constipation, insomnia.
147	107	do	Slight	do	++++		+	−			Pouring, dipping, etc	No complaints.
148	108	do	None	None	++++	+++	Faint	−	Faint	−	Melting and pouring T. N. T	Had determatitis on forearms.
149	109	Good	do	do	++++		+	−	+		Does all kinds of work	Had dermatitis.
150	109	do	Slight	do	++++	+++	+	−	+		Melting and pouring T. N. T. for last 30 days; previously an amatol mix.	No complaints.
151	110	Poor	None	Present	++++		++	Faint	++	++++	Melting and pouring for last 21 days; previously on extruding machine.	Had dermatitis on face and forearms. Lips turned blue at times.

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.....	139	Fair.....	Marked...	...do.....	.....	.....	.....	.....	.....	.....	Melting and pouring.....	Insomnia and loss of appetite.
152	110	Good.....	Slight.....	...do.....	++++++.	+++.....	+.....	−.....	+.....	+.....	Melting and pouring for last 30 days: previously on extruding machine.	No complaints.
153	112	...do.....	Marked...	...do.....	++++++.	.....	+.....	Faint.	++.....	.....	Melting and pouring for last 53 days; previously on extruding machine.	Do.
154	112	...do.....	None.....	None.....	+++.....	Faint.....	−.....	−.....	.....	.....	Melting and pouring.....	Constipation and headaches. Lips turned blue at times.
155	114	Fair.....	Present...	Present...	+++.....	.....	+.....	Faint.	Faint.	.....	Melting and pouring for last 45 days; previously on extruding machine and finishing.	No complaints.
156	114	Good.....	Slight.....	None.....	+++++...	.....	+++++.	...do..	.....	.....	Melting and pouring T. N. T....	Do.
157	117	...do.....	...do.....	...do.....	++++.....	++.....	+.....	...do..	.....	.....	Melting T. N. T. for last 60 days; previously in amatol mix.	Do.
158	117	Fair.....	...do.....	...do.....	++++.....	++.....	+.....	...do..	.....	.....	Melting and finishing.....	Do.
159	118	Good.....	...do.....	...do.....	++++++.	+++++.	Faint....	−−....	.....	−	Melting, pouring, and finishing..	Do.
160	121	...do.....	None.....	...do.....	++++.....	.....	+.....	+.....	.....	.....	Melting and finishing.....	Do.
161	142	Poor.....	Slight.....	Slight.....	++++.....	+.....	−.....	.....	.....	.....	Melting, pouring, stirring, etc...	Do.
162	131	Good.....	None.....	None.....	.....	.....	.....	.....	.....	.....	Melting T. N. T. for last 8 days; previously on extruding machine and amatol mix.	Do.
.....	161	Poor.....	Slight.....	Present...	.....	.....	.....	.....	.....	.....	Finishing since last examination.	No complaints; feels better.
163	131	Fair.....	...do.....	...do.....	++++.....	++.....	+.....	Faint.	.....	.....	Worked on everything in pouring room for last 54 days; previously on extruding machine and in smoke mix.	No complaints.
164	136	Good.....	....do	...do.....	++++.....	++.....	Faint....	.....	.....	.....	Melting T. N. T. and finishing..	Malaise at first; no complaints at present.
165	141	Poor.....	...do.....	...do.....	++++++.	++++...	+.....	Faint.	.....	.....	Amatol mix 2 weeks, extruding machine for 6 weeks, empty shell room 3 weeks, pouring room 1 week, finishing room rest of time.	Occasional headache.
166	148	Good.....	None.....	None.....	++++.....	++.....	−.....	−.....	.....	Faint...	Melting T. N. T.....	Mild dermatitis on face.
167	159	...do.....	Slight.....	Present...	++++++.	+++.....	Faint....	−.....	.....	.....	Melting and pouring and finishing.	No complaints.
168	165	...do.....	...do.....	...do.....	++++.....	++.....	+.....	Faint.	.....	.....	Extruding room until 25 days ago, then in pouring room.	Frequent headaches, dizziness; lips turned blue during warm weather.
169	166	...do.....	None.....	...do.....	.....	.....	.....	.....	.....	.....	Melting, pouring, and finishing.	Claims to have had poisoning soon after beginning work; no complaints since.
170	168	Poor.....	Slight.....	...do.....	++++.....	++++...	+.....	.....	.....	.....	Melting for 15 days; previously in amatol mix.	No complaints.

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TABLE 38—Continued.

No. of worker.	Time of exposure.	State of nutrition.	Cyanosis.	Pallor.	Skin, Webster test.						Occupation.	Remarks.
					Hand.	Wrist.	Forearm.	Upper arm.	Neck.	Face.		
	Days.											
171	177	Good	Slight	None	+++++	++++	++	Faint			Melting and pouring for last 56 days; previously in amatol mix.	Claims to have had poisoning during last summer; now has frequent headaches.
172	178	do	do	Present	++++	++	Faint				Melting, pouring, and finishing	Felt sick and had blue lips at first, but never since.
173	192	Poor	None	do	++++++	+++	−				Melting and pouring for last 20 days; previously in amatol mix.	Lips turned blue during hot weather but never since.
174	196	Good	Slight	Slight	++++	+	+	Faint			Melting T. N. T. for last 54 days; previously shifted from one shop to another.	No complaints.
175	390	do	None	None	+++++	+++	+	−			Foreman in pouring house	Do.
176	14	do	Slight	do	++		Faint				Melting, pouring, and finishing	Do.
177	17	do	do	do	++++	+++	+	Faint			Melting and pouring	Do.
178	21	Poor	None	do							Melting T. N. T.	Thoracic pains.
179	37	Good	do	Slight	++++	+++	+	−	+	−	Melting and pouring	No complaints.
180	39	do	Slight	None	++++	+	−				Melting T. N. T.	Do.
181	61	do	do	do	+++++	++++	++	Faint			do	Complains of dizziness and headaches.
182	69	Fair	Marked	Marked	+++	+	Faint				Dipping and pouring T. N. T	Nose and throat irritated.
183	92	Poor	Slight	None	++++	++	do				Finishing and occasionally melting.	Headaches at first. Slight loss of appetite.
184	155	Good	Marked	do	+++++	++++	+	Faint			Melting and pouring for last 41 days; previously in amatol mix.	Blue lips at first.
185	171	do	Slight	Present	++++	++	+				Melting and pouring most of the time.	Claims to have had poisoning during last summer.
186	191	do	do	None	+++		Faint	−			Melting and pouring T. N. T. for last 24 days; previously in amatol mix.	Headaches.
187	200	do	None	do	+++++	+	−		−	−	Finishing; occasionally melting	No complaints.

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TABLE 38—Continued.

No. of worker.	Time of exposure.	State of nutrition.	Cyanosis.	Pallor.	Skin, Webster test.						Occupation.	Remarks.
					Hand.	Wrist.	Forearm.	Upper arm.	Neck.	Face.		
	Days.											
224	166	Good	None	Present							Finishing	No complaints.
225	168	...do	Slight	None	++	+	Faint				Finishing; blows out booster cavity.	Do.
226	175	...do	None	...do							Drill house most of time	Last summer "turned blue in face"; had to be temporarily taken off of T. N. T.
227	175	...do	...do	...do	++++		+	Faint			Finishing	Had blue lips at first.
228	184	...do	Slight	Present	+++	+	Faint				Finishing; blows out booster cavity for last 45 days; previously on extruding machine.	Had dermatitis.
229	184	Poor	Present	None	+	Faint	...do				Last 14 days finishing; previously on extruding machine.	Headaches; had dermatitis at one time.
230	191	Good	None	...do							Finishing	No complaints.
231	197	Poor	...do	...do	++		−				Worked all over plant; cleaning loaded shells.	Do.
232	244	Good	Marked	Present	++++	−	−				Finishing	Occasional headache, constipation, and blueness of lips.
233	275	Poor	None	None	++++				++		...do	Constipation.
234	260	Good	Slight	...do	++++	+++	Faint				Pouring and stirring	Shortness of breath, headache.
235	360	...do	None	...do	+		−				Supervisor	Had dermatitis last summer.
236	394	...do	...do	...do	−		−				In empty-shell room most of time.	No complaints.
237	545	...do	Slight	Slight	++++++		+	Faint			Amatol loading until 1 month ago; now finishing.	Do.

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TABLE A.—*Classification of cases with anemia.*

[Data compiled from an examination of 149 male and 88 female T. N. T. workers.]

Class.	Number of cases.					Hemoglobin in per cent.			
						Males.		Females.	
	Per cent of workers examined.	Males.	Per cent of males examined.	Females.	Per cent of females examined.	Average.	Extremes.	Average.	Extremes.
Slight anemia	50.2	80	53.7	39	44.3	79	97–71	76	91–71
Moderate anemia	21.5	32	21.5	19	21.6	67	70–61	66	70–62
Severe anemia	.4	1	.7	.....	.....	57	57	.....	.....
Total number of anemia cases	72.5	113	76	58	66	75	97–57	73	85–62

Class.	Erythrocyte counts.				Cases with poikilocytosis or anisocytosis.	Cases with nucleated red cells in circulation.	Leucocytes.		
	Males.		Females.				Cases with count below 5,000.	Cases with count above 10,000.	Cases with relative lymphocytosis.
	Average.	Extremes.	Average.	Extremes.					
					P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
Slight anemia	4,306,000	{5,736,000 / 2,928,000}	4,210,000	{5,440,000 / 2,888,000}	38	14	2.5	23	46
Moderate anemia	4,181,000	{5,200,000 / 3,488,000}	4,064,000	{4,704,000 / 3,224,000}	41	22	8	22	61
Severe anemia	2,936,000	2,936,000	.....	.....	0	0	.....	100	100
Total number of anemia cases.	4,250,000	{5,688,000 / 2,936,000}	4,170,000	{5,440,000 / 2,880,000}	39	18	4	22	49

TABLE B.—*Relation of anemia to age, time of exposure to T. N. T., and cyanosis.*

[Data compiled from an examination of 149 male and 88 female T. N. T. workers.]

Class.	Age in years.		Time of exposure in days.		Number of cases with cyanosis and anemia.			Number of cases with pallor and anemia.		
	Average.	Extremes.	Average.	Extremes.	Total number of cases.	Males.	Females.	Total number of cases.	Males.	Females.
					Per ct.			*Per ct.*		
Slight anemia	28	18–70	122	8–545	45	46	8	33	28	11
Moderate anemia	30	18–53	102	8–390	55	21	7	49	16	9
Severe anemia	20	20	24	24	0	0	0	0	0	0
Total	29	18–70	87	8–545	48	67	15	39	44	20

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TABLE C.—*Blood changes and symptoms in workers with and without anemia.*

	Cases.	Poikilocytosis or anisocytosis.	Nucleated red cells.	Leucocytes.			Cyanosis.	Pallor.
				Below 5,000.	Above 10,000.	Relative lymphocytosis.		
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
With anemia.....	171	39	18	4	22	49	48	39
Without anemia.....	66	32	6	0	15	52	36	27

DIET OF T. N. T. WORKERS.

Men's mess, 25 cents per meal.

Day.	Breakfast.	Dinner.	Supper.
Monday.....	Oatmeal. Fried pork sausage. Hashed browned potatoes. Bread and butter. Coffee.	Bologna sausage. Mashed potatoes. Lima beans. Apple charlotte. Bread and butter. Cocoa.	Steamed frankfurters. Boiled potatoes. Green peas. Bread pudding. Bread and butter. Tea.
Tuesday.....	Apricots. Pork chops. Lyonnaise potatoes. Bread and butter. Coffee.	Liver with onions. Mashed potatoes. Kidney beans. Bread pudding. Cocoa.	Roast beef. Mashed potatoes. Stewed tomatoes. Pastry. Bread and butter. Tea.
Wednesday...	Oatmeal. Hamburger steak, onions. Hashed browned potatoes. Bread and butter. Coffee.	Veal stew. Boiled potatoes. Navy beans. Corn bread. Pudding. Cocoa.	Ham. Mashed potatoes. Blackeyed peas. Corn bread and butter. Pudding. Tea.
Thursday.....	Stewed prunes. Fried pork sausage. Hashed browned potatoes. Hot bread and butter. Coffee.	Stewed frankfurters. Mashed potatoes. Black-eyed peas. Corn bread and butter. Bread pudding. Cocoa.	Roast veal. Boiled potatoes. Green peas. Bread and butter. Pudding. Tea.
Friday.....	Oatmeal. Fried liver and onions. Potatoes. Bread and butter. Coffee.	Roast veal. Mashed potatoes. Spaghetti. Bread and butter Pudding. Cocoa.	Roast pork. Kidney beans. Mashed potatoes. Stewed prunes. Bread and butter. Tea.
Saturday.....	Stewed apples. Fried pork sausage. Hashed browned potatoes. Bread and butter. Coffee.	Roast pork. Boiled potatoes. Green peas. Bread and butter. Pudding. Cocoa.	Roast beef. Mashed potatoes. Lima beans. Bread and butter. Pudding. Tea.
Sunday.....	Hashed browned potatoes. Oatmeal. Fried herring. Bread and butter. Coffee. Sirup.	Bacon and cabbage. Mashed potatoes. Lima beans. Bread and butter. Rice pudding. Coffee.	Veal stew with vegetables. Boiled potatoes. Succotash. Bread and butter. Bread pudding. Tea.

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Women's mess, 25 cents per meal.

Day.	Breakfast.	Dinner.	Supper.
Monday.....	Oatmeal. Pork chops. Corn bread. Stewed peaches. Tea or coffee.	Beef sirloin. Creamed potatoes. Spaghetti and tomatoes. Rice and apple pudding. Tea, coffee, or cocoa.	Vegetable soup. Baked ham. Pastry. Lyonnaise potatoes. Carrots and peas. Apple roll. Tea, coffee, or cocoa.
Tuesday.....	Oatmeal. Canned sausage. Graham bread. Stewed peas. Tea or coffee.	Roast lamb. Mashed potatoes. Green peas. Pudding. Bread and butter. Tea, coffee, or cocoa.	Tomato soup. Beefsteak pie. Stewed corn. Chocolate cake. Tea, coffee, or cocoa.
Wednesday...	Oatmeal and cereal. Canned sausage. Graham bread. Stewed pears. Tea or coffee.	Roast lamb. Mashed potatoes. Green peas. Bread and butter pudding. Tea, coffee or cocoa.	Beefsteak pie. Stewed corn. Chocolate cake. Tea, coffee or cocoa.
Thursday.....	Cereals. Canned sausage. Corn cakes. Stewed prunes. Tea or coffee.	Roast chicken. Mashed potatoes. Creamed parsnips. Pies. Tea, coffee or cocoa.	Chicken soup. Veal roast. Browned potatoes. Green peas. Cocoanut pudding. Tea, coffee or cocoa.
Friday.....	Cereals. Scrambled eggs. Corn muffins. Stewed pears. Tea or coffee.	Salmon cutlets. Fried potatoes. Baked beans. Apple rolls. Tea, coffee or cocoa.	Soup. Roast veal. Mashed potatoes. Butter beets. Jelly roll. Tea, coffee, or cocoa.
Saturday.....	Cereals. Pork chops. Hot corn bread. Stewed prunes. Tea or coffee.	Saulsbury steak. Lyonnaise potatoes. Spaghetti. Cottage pudding. Tea, coffee, or cocoa.	Vegetable soup. Roast beef. Hashed browned potatoes. Rice. Chocolate cake. Tea, coffee, or cocoa.
Sunday.....	Cereals. Fried liver. Hot corn bread. Apple sauce. Tea or coffee.	Boiled ham and cabbage. Potatoes. Chocolate pudding. Tea, coffee, or cocoa.	Pea soup. Roast beef. Potatoes. Spaghetti with cheese cake. Tea, coffee, or cocoa.

Short-order restaurant.

Breakfast.—Oatmeal 10 cents; grapenuts 10 cents; corn flakes 10 cents; shredded wheat 10 cents; post toasties 10 cents; sirloin steak 30 cents; fried liver 25 cents; hamburger steak 30 cents; hashed potatoes 5 cents; fried eggs (2) 25 cents; and (3) 35 cents; ½ grapefruit 10 cents; stewed apples 10 cents; orange 10 cents; banana 5 cents; apple 5 cents; buttered toast 10 cents; coffee, tea or cocoa 5 cents.

Dinner and supper.—Vegetable soup 10 cents; roast beef 30 cents; veal stew 30 cents; spring lamb with green peas 35 cents; calf liver and onions 30 cents; hamburger steak and onions 35 cents; mashed potatoes 5 cents; stewed tomatoes 5 cents; boiled beans 5 cents; buttered beets 5 cents; cabbage 5 cents; baked beans 10 cents; bread pudding 5 cents; boiled rice 5 cents; rice pudding 5 cents; orange 10 cents; apple 5 cents; banana 5 cents; jelly cake 10 cents; pie 5 cents; apple sauce 10 cents; coffee, tea or cocoa 5 cents.

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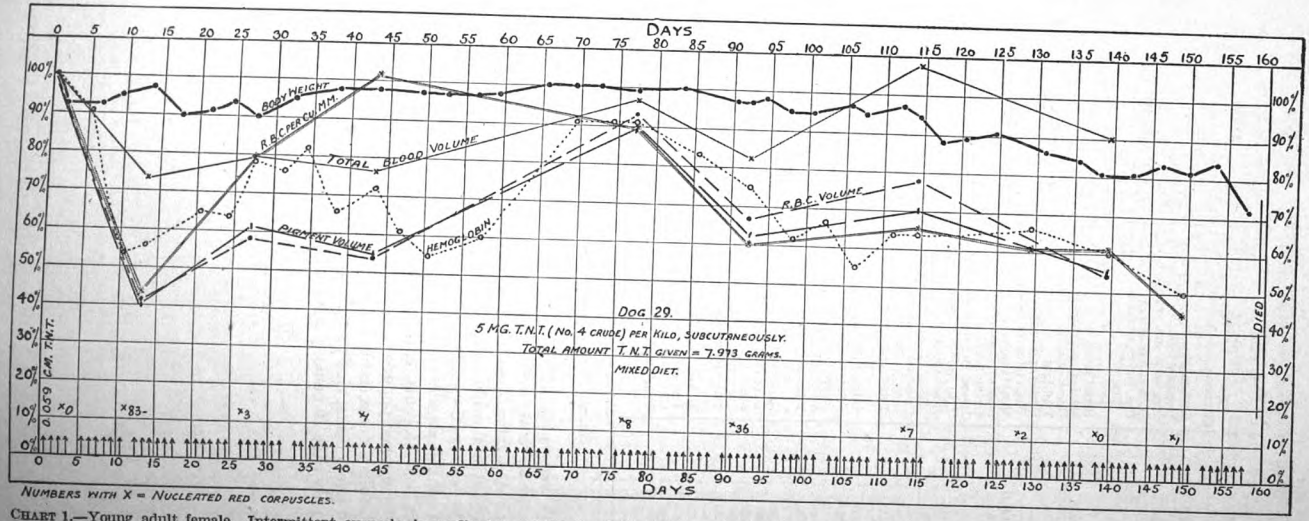

CHART 1.—Young adult female. Intermittent cyanosis, incoordination, and salivation during first part of experiment. No icterus. Food consumption good. Leucocytes 9,000 to 20,600. See Table 1 for the individual and the differential counts. Reticulated reds 1 to 91 during the first 44 days. Nucleated reds none to 83. Anisocytosis, poikilocytosis, and basophilia.

Autopsy.—Oral mucous membrane shows a few superficial ulcerations. Bone marrow hyperplastic. Bone marrow, liver capillaries, and spleen pulp contain numerous phagocytes loaded with coarsely granular hemosiderin. Liver cells are normal.

Note the rapid destruction of blood during first two weeks, simultaneously with the marked increase of the nucleated reds in the circulating blood (83 to 200 white cells). This period is followed by a gradual regeneration of the blood in the following two months during which time the number of nucleated reds is small (1 to 3). This evident blood regeneration may be due to a compensating hyperactivity of the hematopoietic organs or a period of tolerance during which time the body is able to successfully cope with the poison. Increased blood destruction follows the 80th day accompanied by an increase in the nucleated red cells. The nucleated reds probably indicate a very active hematopoietic system.

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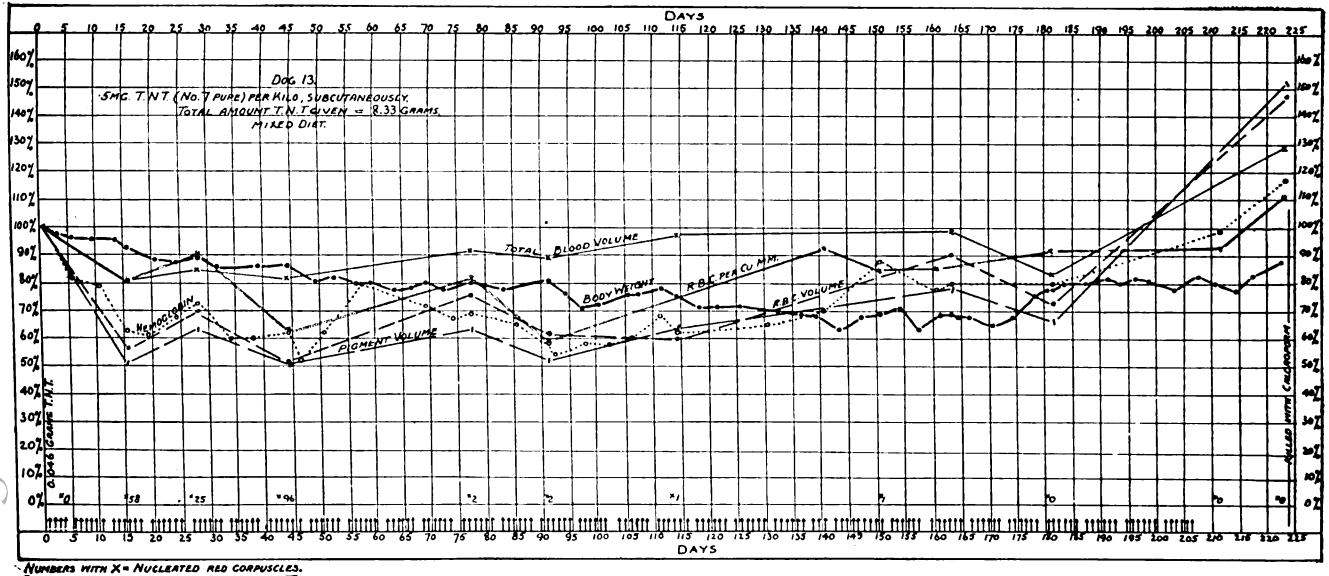

CHART 2.—Adult female. Intermittent cyanosis, incoordination, and salivation during first 53 days. No icterus. Marked intoxication during second and third weeks. Food consumption reduced. Leucocytes 9,800 to 20,000. See Table 2 for the individual and the differential counts. Reticulated reds 2 to 112 during the first 45 days. Nucleated red corpuscles none to 96. Especially numerous during first 45 days. Anisocytosis, poikilocytosis, and basophilia.

Autopsy.—Negative.

Note rapid blood regeneration after the 207th day when T. N. T. administration was discontinued.

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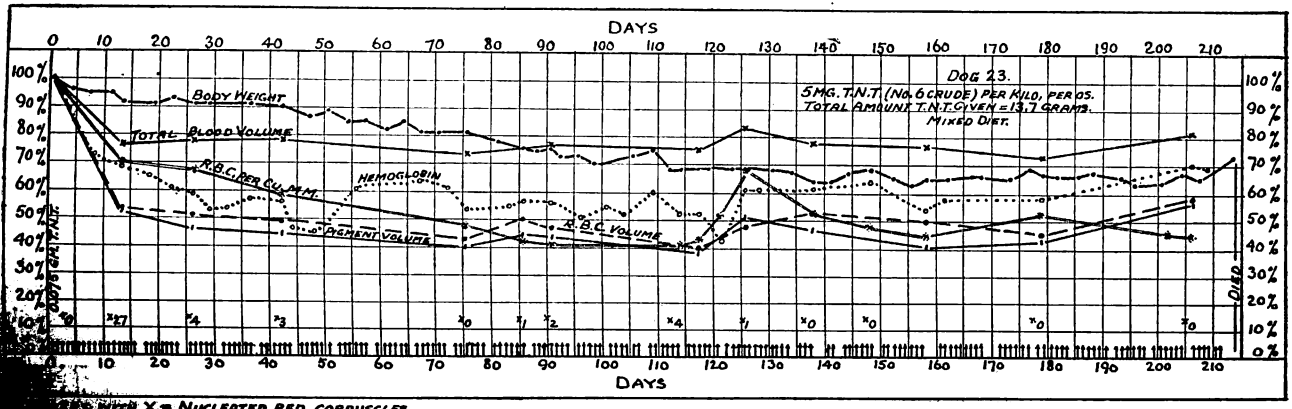
DAYS
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210
Dog 23.
5 MG. T.N.T. (No. 6 CRUDE) PER KILO, PER OS.
TOTAL AMOUNT T.N.T. GIVEN = 13.7 GRAMS.
MIXED DIET.
BODY WEIGHT
TOTAL BLOOD VOLUME
R.B.C. PER CU. M.M.
HEMOGLOBIN
PIGMENT VOLUME
R.B.C. VOLUME
BODY WEIGHT IN KILOS
DIET
100% 90% 80% 70% 60% 50% 40% 30% 20% 10% 0%
×0 ×27 ×4 ×3 ×0 ×1 ×2 ×4 ×1 ×0 ×0 ×0 ×0
DAYS

WHEN X = NUCLEATED RED CORPUSCLES.

male. Cyanosis, incoordination, and salivation present during first part of experiment. No icterus. Satisfactory food consumption. Leucocytes 5,800 to 14,600. the individual and the differential counts. Reticulated reds 1 to 30 during the first 43 days. None to 27 nucleated reds. Anisocytosis, poikilocytosis, and basophilia. diffuse nephritis, hyperplastic bone marrow, liver normal.

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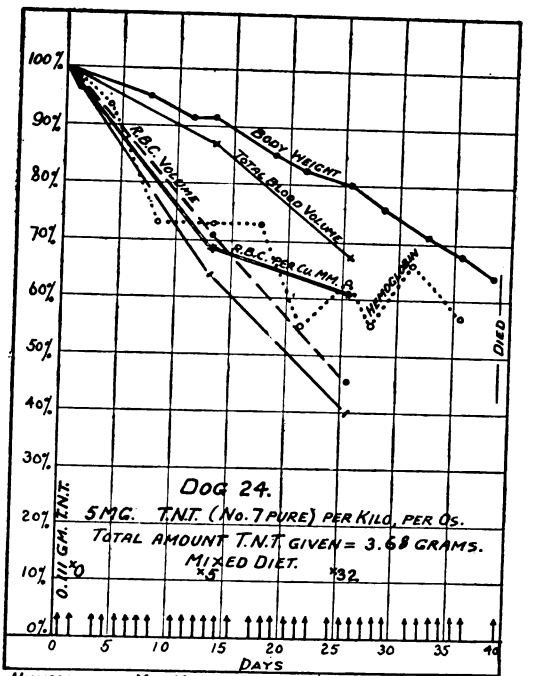

CHART 4.—Old male. Slight cyanosis, salivation, and a marked incoordination. No icterus. Gradual loss of appetite. Leucocytes 11,200 to 24,200. See Table 4 for the individual and the differential counts. Increase of reticulated reds from 3 to 162 during the first 26 days. Anisocytosis, poikilocytosis, and basophilia.

Autopsy.—Chronic diffuse nephritis, hyperplastic bone marrow; few small areas of liver necrosis. Bone marrow, liver capillaries, mesenteric lymph glands, and spleen pulp contain phagocytes loaded with hemosiderin. Slight myeline degeneration of sciatic nerve.

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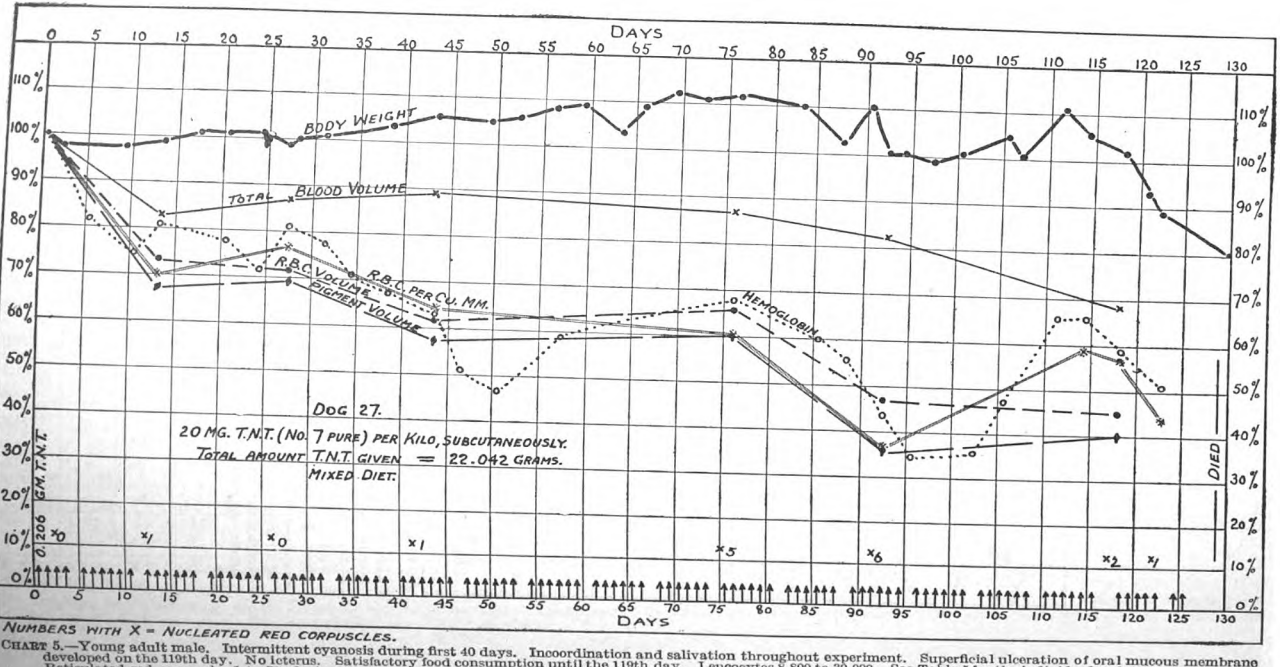

NUMBERS WITH X = NUCLEATED RED CORPUSCLES.

CHART 5.—Young adult male. Intermittent cyanosis during first 40 days. Incoordination and salivation throughout experiment. Superficial ulceration of oral mucous membrane developed on the 119th day. No icterus. Satisfactory food consumption until the 119th day. Leucocytes 8,800 to 39,000. See Table 5 for the individual and differential counts. Reticulated red corpuscles 1 to 78, during the first 44 days. Nucleated reds varied from none to six. Greatest increase from 77th to 93d day.

Autopsy.—Extensive superficial ulceration of oral mucous membrane. No icterus. Bone marrow hyperplastic. Liver shows accumulation of fat droplets in cells about efferent veins. Bone marrow, spleen pulp, and liver capillaries contain phagocytes loaded with hemosiderin.

It is evident in this experiment that the meat consumption was not sufficient to prevent malnutrition as evidenced by the appearance of stomatitis at the end of experiment. See legend, Chart 1.

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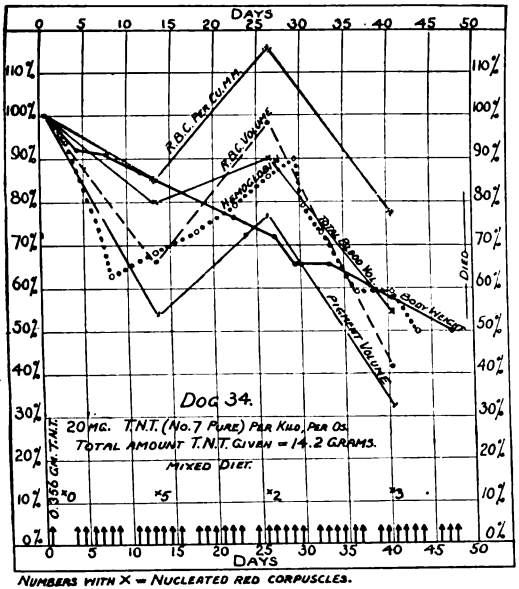

CHART 6.—Adult male. Slight cyanosis, incoordination, and salivation. No icterus. Gradual loss of appetite accompanied by marked loss in body weight. Leucocytes varied from 11,800 to 27,400. See Table 6 for the individual and differential counts. Reticulated reds varied from 1 to 54. Nucleated reds from none to five. Anisocytosis and basophilia.

Autopsy.—Extreme emaciation. No icterus. Bone marrow, spleen pulp and liver capillaries contain hemosiderin-holding phagocytes.

Note the very active blood regeneration between the 14th and 27th days.

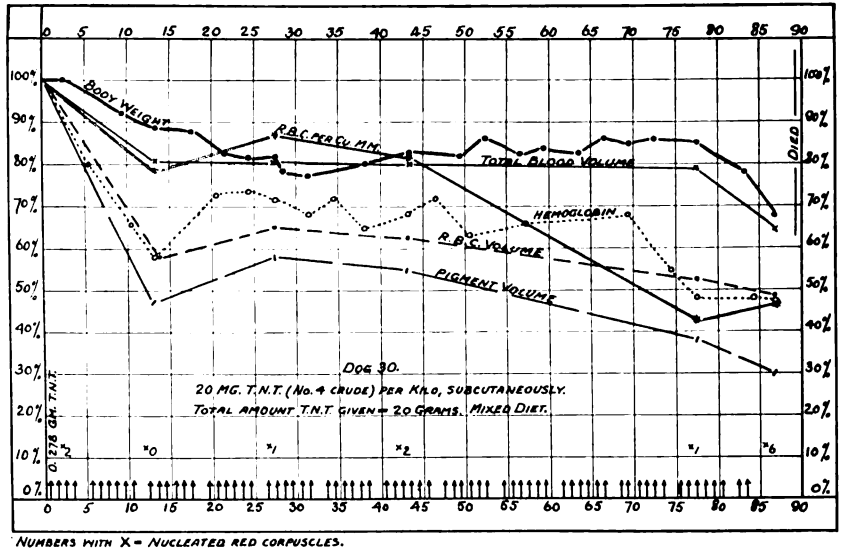

CHART 7.—Young adult female. Cyanosis, incoordination, and salivation. No icterus. Appetite fair. Superficial ulceration of oral mucous membranes developed on 83d day, indicating malnutrition. Leucocytes varied from 13,200 to 34,200. See Table 7 for the individual and differential counts. Reticulated reds varied from none to 38, during the first 44 days. Nucleated reds varied from none to six. Anisocytosis and poikilocytosis.

Autopsy.—No icterus. Bone marrow hyperplastic. Spleen pulp, liver capillaries, and bone marrow contain hemosiderin-holding phagocytes. Liver cells normal.

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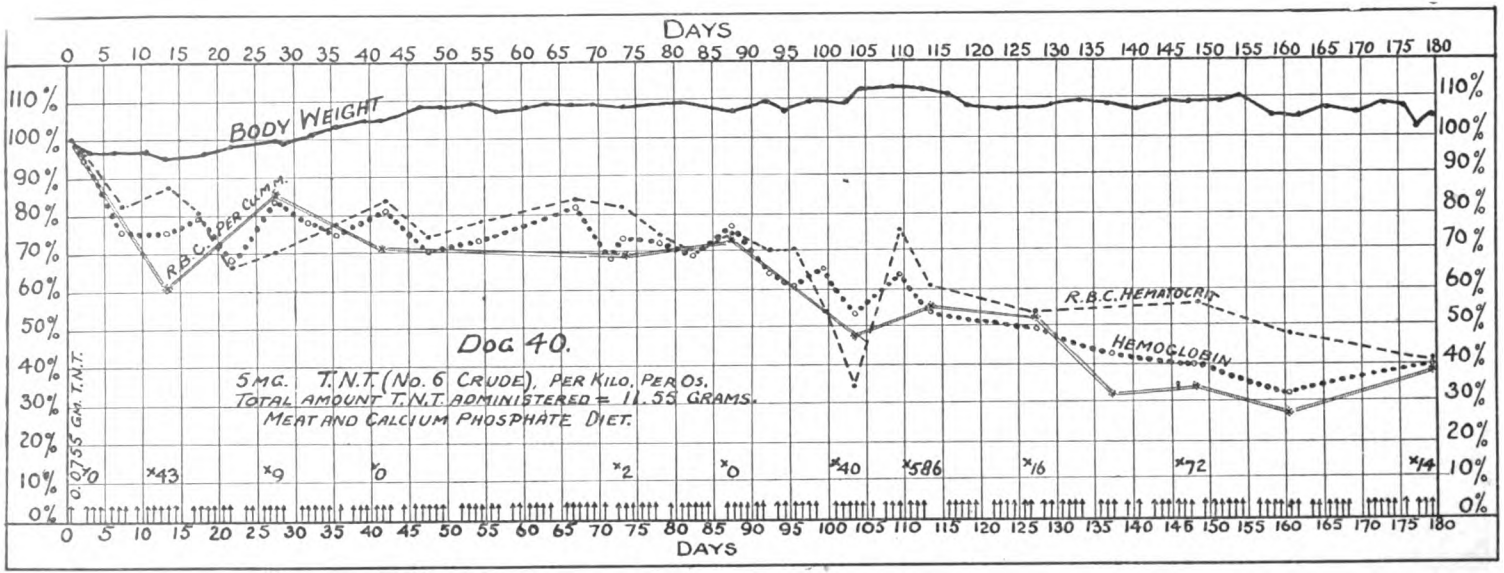

NUMBERS WITH × = NUCLEATED RED CORPUSCLES.

CHART 8.—Adult male. Incoordination and salivation. No cyanosis. Oral mucous membranes became very pale toward the end of the experiment. Food consumption very good. Animal very well nourished throughout the entire experiment. Leucocytes varied from 6,400 to 26,000. See Table 8 for the individual and the differential counts. Reticulated reds varied from 1 to 8, during the first 42 days. Nucleated reds from none to 586. Animal died on the 206th day.

Autopsy.—Very well nourished. No icterus. Lung oedema. Increase in pericardial and pleural fluids. Oedema and cloudy swelling of kidneys. Liver cells abundantly loaded with fat droplets, especially the cells composing the central three-fifths of the lobules. Spleen is swollen. Bone marrow intensely hyperplastic. Hemosiderin-holding phagocytes in spleen pulp, bone marrow, and liver capillaries.

Note the rapid blood destruction during first two weeks with the simultaneous increased activity of the blood forming organs as indicated by the number of normoblasts in the peripheral circulation, followed by a period during which a fair balance is maintained between blood destruction and regeneration with comparatively little strain on the hemotopoietic system. On the 96th day there is again evidence of an intensified blood destruction as shown by the fall in hemoglobin and red count and the enormous number of erythroblasts in the circulation (586 erythroblasts seen in counting 200 white corpuscles). In contradistinction to the previous period following the first active blood destruction, this period extends over several weeks during which time there are numerous erythroblasts in the circulating blood.

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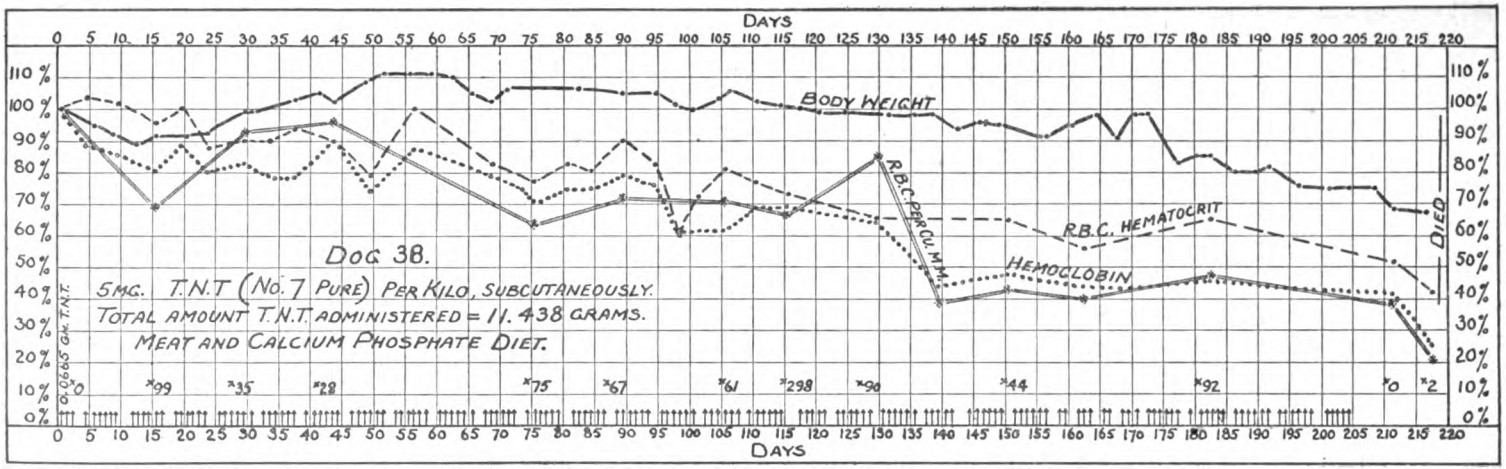

NUMBERS WITH X = NUCLEATED RED CORPUSCLES.

CHART 9.—Adult male. Cyanosis, salivation, and incoordination at times during the first 80 days. *Slight icterus* of conjunctivæ between the 20th and 80th days. Urine contained considerable bile pigment throughout the experiment. Satisfactory food consumption and state of nutrition until the 170th day, when the animal gradually lost its appetite and declined in weight. Leucocyte count varied from 11,400 to 25,200. See Table 9 for the individual and the differential counts. Reticulated reds 1 to 13 during first 44 days. Nucleated reds varied from none to 298. Anisocytosis, poikilocytosis, and basophilia.

Autopsy.—No icterus. Heart shows a small infarct 1 centimeter in diameter in muscle of left ventricle. Bone marrow is hyperplastic. Liver cells are normal, capillaries contain a few hemosiderin-holding phagocytes. Bone marrow and spleen pulp contain hemosiderin-holding phagocytes.

Note the number of nucleated reds in the circulating blood after the first two weeks of blood destruction. In spite of the icterus during the first part of the experiment, and the considerable quantity of bile pigment in the urine, no liver lesions are found. T. N. T. discontinued on the 204th day.

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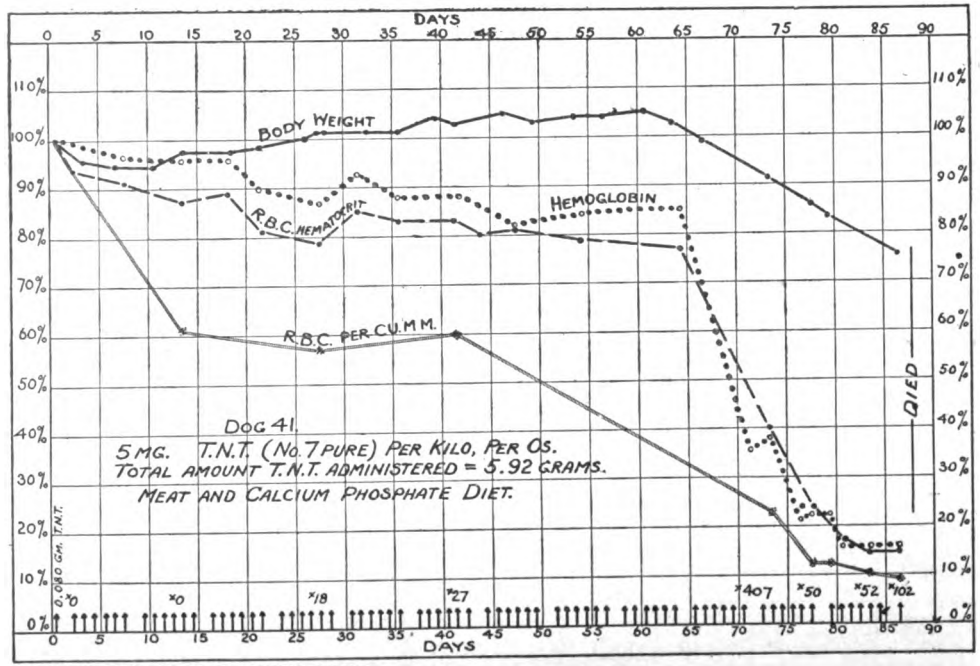

NUMBERS WITH X = NUCLEATED RED CORPUSCLES.

CHART 10.—Adult male. Slight cyanosis, salivation, and marked incoordination. No icterus. Food consumption satisfactory until 78th day, when animal developed distemper. Leucocytes varied from 13,000 to 41,000. See Table 10 for the individual and the differential count. Reticulated reds from 1 to 16 during first 42 days. Nucleated reds from none to 407. Anisocytosis, poikilocytosis, and basophilia.

Autopsy.—No icterus. Terminal bronchopneumonia. Acute splenic tumor. Pulp contains megalocaryocytes, normoblasts, and hemosiderin-holding phagocytes. Cloudy swelling of kidneys. Liver is swollen and shows accumulation of fat droplets about the efferent veins. The liver capillaries contain hemosiderin-holding phagocytes. Bone marrow is hyperplastic and contains many hemosiderin-holding phagocytes.

Note the tremendous blood destruction between 65 and 75 days and the great increase of erythroblasts in the peripheral circulation. This period is followed by distemper on the 78th day.

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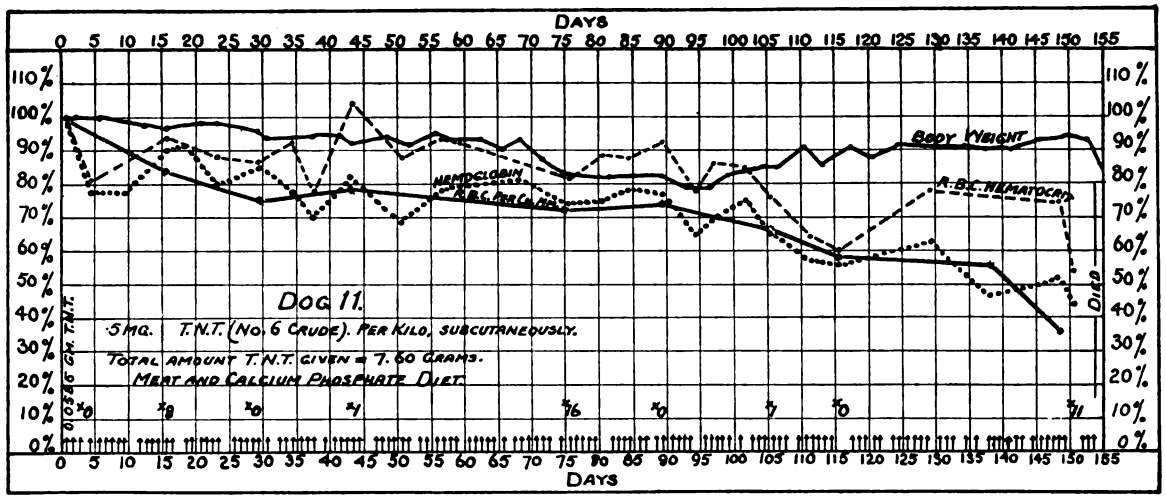
DAYS
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120 125 130 135 140 145 150 155
110% 100% 90% 80% 70% 60% 50% 40% 30% 20% 10% 0%
BODY WEIGHT
HEMOGLOBIN
R.B.C. NUMBER
DOG 11.
·5 MG. T.N.T. (No. 6 CRUDE). PER KILO, SUBCUTANEOUSLY.
TOTAL AMOUNT T.N.T. GIVEN = 7.60 GRAMS.
MEAT AND CALCIUM PHOSPHATE DIET.
DIED
DOSAGE GM. T.N.T.
X0 X8 X0 X4 X6 X0 X7 X0 X11
DAYS

NUMBERS WITH X = NUCLEATED RED CORPUSCLES.

CHART 11.—Adult female. Cyanosis and salivation, especially during the first 70 days. No icterus. Food consumption fairly good. Leucocytes varied between 11,200 and 23,600. See Table 11 for the individual and the differential counts. Reticulated red cells from 4 to 28 during the first 44 days. Nucleated reds varied between none and 16. Anisocytosis, poikilocytosis, and basophilia.

Autopsy.—No icterus. Terminal bronchopneumonia. Kidneys swollen. Spleen congested, pulp contains many megalocaryocytes, normoblasts, and a few hemosiderin-containing phagocytes. Liver is swollen and shows an extensive accumulation of fat droplets about efferent veins. Bone marrow extremely hyperplastic.

Note the gradual blood destruction and intermittent moderate increase of erythroblasts in the peripheral circulation.

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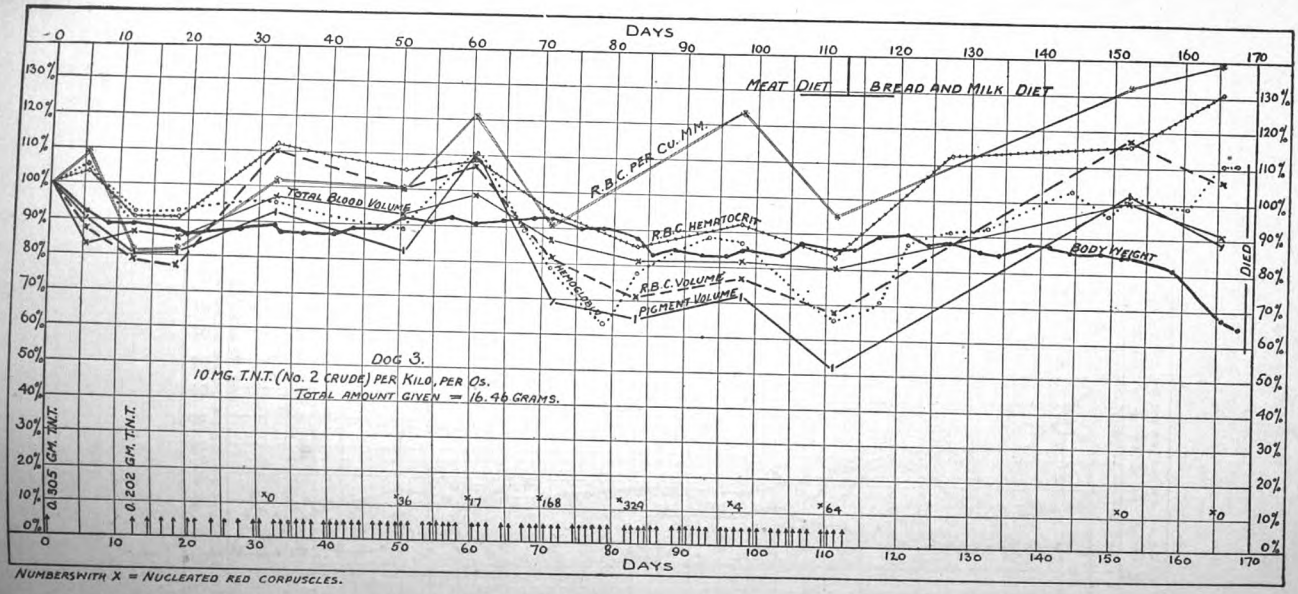

CHART 12.—Adult female. Temporary cyanosis and salivation and persistent incoordination. No icterus. Loss of appetite and gradual loss in weight. Leucocytes varied 5,000 to 26,800. See Table 12 for the individual and the differential counts. Reticulated reds from 3 to 52 during first 112 days. Nucleated reds from none to 329. Anisocytosis, poikilocytosis, and basophilia.

Autopsy.—Oral mucous membrane, including the under surface and sides of the tongue, is superficially ulcerated. The mucous membrane comes away in long shreds leaving a raw and injected surface. No icterus. Mucosa of duodenum and upper half of jejunum is swollen and congested. Spleen pulp contains many hemosiderin-holding phagocytes. Liver and kidneys congested. Bone marrow intensely hyperplastic and contains hemosiderin-holding phagocytes.

During the first two months the anæmia was moderate, followed by a period of five weeks during which the anæmia was intensified and a large number of erythroblasts were found in the circulating blood. In order to test the functional activity of the blood-forming organs the dog was taken off T. N. T. and the diet changed from meat, bread, and milk on the 114th day, which resulted in a complete blood regeneration in 39 days. Thus it is shown that the hematopoetic organs had not lost their function. The animal died as a result of the deficient diet as evidenced by the superficial ulceration of the oral mucous membrane.

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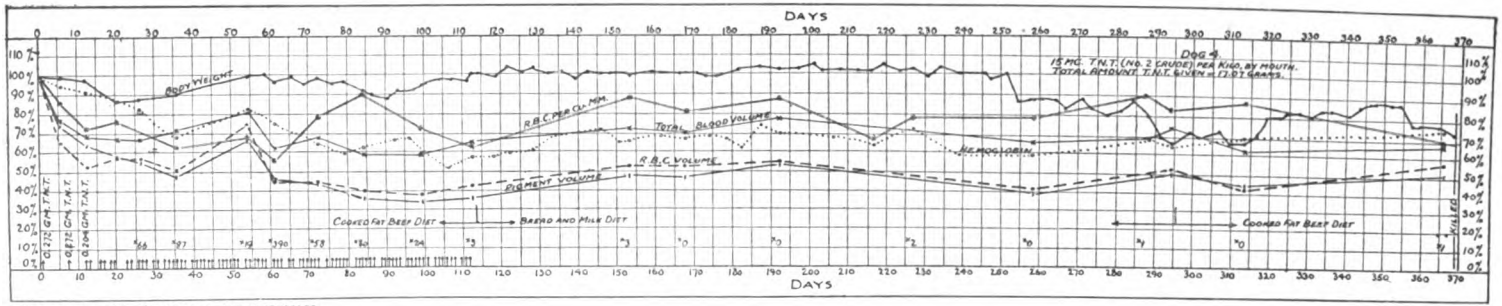

NUMBERS WITH X = NUCLEATED RED CORPUSCLES.

CHART 13.—Old female. Transient slight cyanosis. Incoordination. No icterus. Six convulsions on the 19th day. Satisfactory food consumption. Leucocytes varied from 13,600 to 30,200. See Table 13 for the individual and the differential counts. Nucleated reds from none to 390. Reticulated reds from 12 to 102 between 27th and 113th days. Anisocytosis, poikilocytosis, and basophilia.

Autopsy.—Negative. Bone marrow of femur chiefly fat with many islands of active myeloid tissue.

Note the parallelism between the increase of nucleated red cells in the circulating blood and the degree of the anaemia during the first 114 days. The T. N. T. was then discontinued and the diet changed to bread and milk. During the following 182 days there was little evidence of blood regeneration. On the 196th day the diet was changed to meat without promoting any marked blood regeneration.

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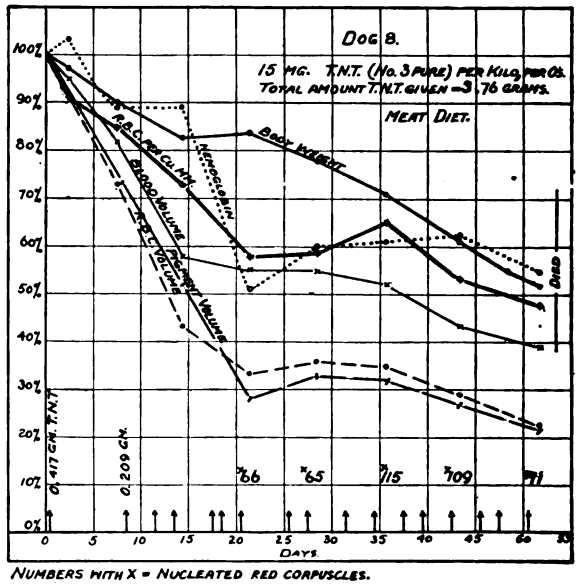

NUMBERS WITH X = NUCLEATED RED CORPUSCLES.

CHART 14.—Old female. Marked cyanosis on second day. Incoordination present throughout experiment, most marked during first period. Food consumption intermittently decreased during periods of severe intoxication. Leucocytes varied from 12,800 to 117,500. See Table 14 for individual leucocyte counts and differential counts. The leucocyte count of 117,500 was associated with an attack of distemper. Reticulated reds from 11 to 140 between the 15th and 52d days. The nucleated reds varied between 11 and 115 between the 22d and 52d days. Anisocytosis.

Autopsy.—Extreme emaciation. No icterus. Bone marrow very hyperplastic and contains a few hemosiderin-holding phagocytes. The spleen pulp and liver capillaries contain many hemosiderin-holding phagocytes. Fairly extensive myeline degeneration of sciatic nerve.

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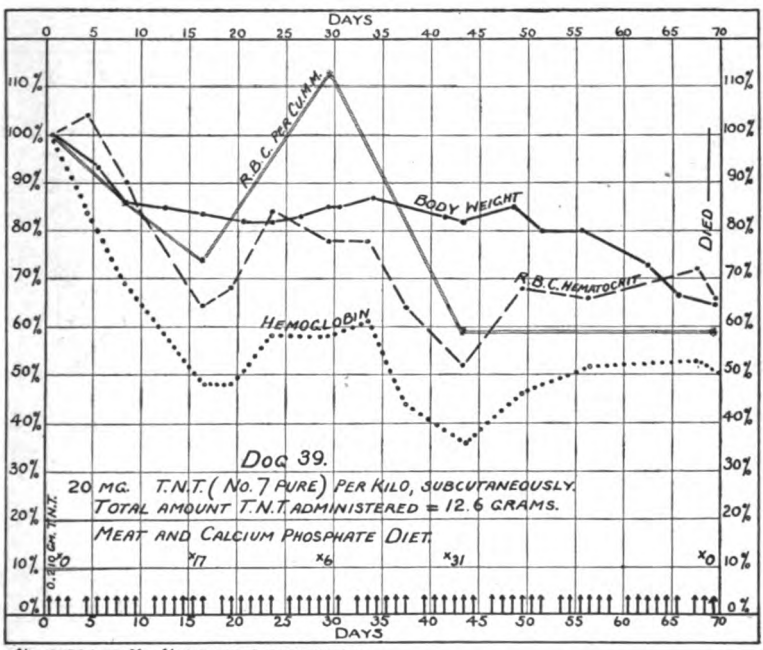
DAYS
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70
110% 100% 90% 80% 70% 60% 50% 40% 30% 20% 10% 0%
R.B.C. PER CU.MM.
BODY WEIGHT
DIED
R.B.C. HEMATOCRIT
HEMOGLOBIN
Dog 39.
20 MG. T.N.T. (No. 7 PURE) PER KILO, SUBCUTANEOUSLY.
TOTAL AMOUNT T.N.T. ADMINISTERED = 12.6 GRAMS.
MEAT AND CALCIUM PHOSPHATE DIET.
0.2 GM. T.N.T.
x0 x17 x6 x31 x0
DAYS

NUMBERS WITH X = NUCLEATED RED CORPUSCLES.

CHART 15.—Young adult male. Cyanosis, incoordination, and salivation. Slight icterus of conjunctivae between 33d and 38th days with recurrence a few days before death. Food consumption gradually decreased. Leucocytes varied between 18,400 and 34,200. Reticulated reds from none to 36. Nucleated reds from none to 31. Anisocytosis and basophilia.

Autopsy.—Slight icterus. Kidney cells are swollen and granular, many of the collecting tubules contain hyaline casts and many of the glomerular capsules are filled with coagulated fluid. Liver is swollen, capillaries contain many endothelial cells loaded with hemosiderin. Spleen small and firm. The pulp is loaded with hemosiderin-holding phagocytes. Bone marrow very hyperplastic, containing a great number of phagocytes loaded with hemosiderin.

Note that the increase in the numbers of the erythroblasts is associated with more active blood regeneration.

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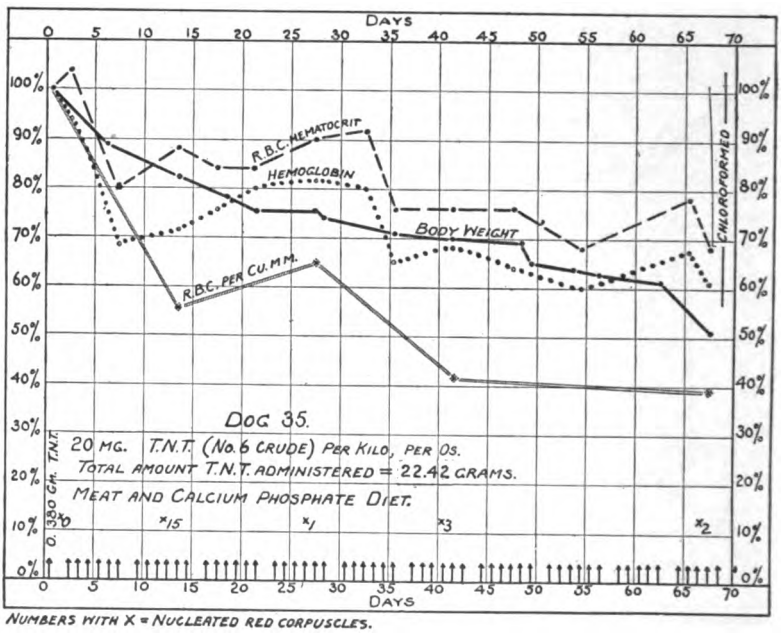
DAYS
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70
100% 90% 80% 70% 60% 50% 40% 30% 20% 10% 0%
R.B.C. HEMATOCRIT
HEMOGLOBIN
BODY WEIGHT
R.B.C. PER CU. MM.
CHLOROFORMED
DOG 35.
20 MG. T.N.T. (No. 6 CRUDE) PER KILO, PER OS.
TOTAL AMOUNT T.N.T. ADMINISTERED = 22.42 GRAMS.
MEAT AND CALCIUM PHOSPHATE DIET.
0.330 GM. T.N.T.
x0 x15 x1 x3 x2
DAYS

NUMBERS WITH X = NUCLEATED RED CORPUSCLES.

CHART 16.—Adult male. Intermittent cyanosis, incoordination, and salivation. Gradual loss of appetite. No icterus. Leucocytes varied from 16,200 to 39,800. See Table 16 for the individual counts and differential counts. Reticulated cells varied from 3 to 40 during first 42 days. Nucleated reds from none to 15. Basophilia and anisocytosis. Animal moribund on the 69th day and killed with chloroform.

Autopsy.—Extreme emaciation. No icterus. Bone marrow hyperplastic. Spleen is small and firm. Malpighian bodies show areas of coagulation necrosis. Pulp contains numerous pigmented phagocytes. Liver capillaries contain a few endothelial Kupffer cells holding hemosiderin.

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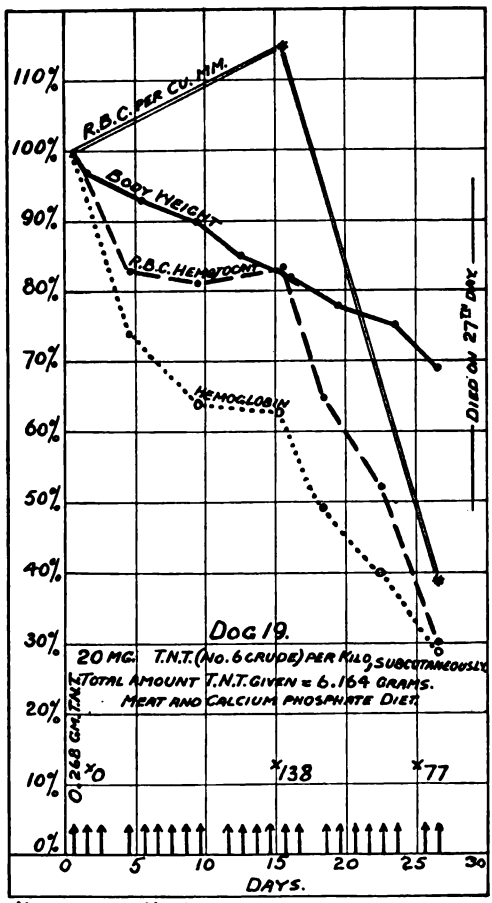

CHART 17.—Young adult, male. Cyanosis, incoordination, and salivation. Rapid loss of appetite. Slight icterus appearing on the 19th day increasing in intensity until death. Plasma contained bile pigments from the 19th day until death. Urine contained large amounts of bile pigment. Leucocytes varied from 19,600 to 83,200. See Table 17 for individual counts and differential counts. Reticulated reds from 2 to 74. Nucleated reds from none to 138. Anisocytosis and basophilia.

Autopsy.—Definite icterus. Spleen swollen, pulp heavily sprinkled with hemosiderin-holding phagocytes. Liver shows accumulation of fat in the liver cells about the central veins. The capillaries contain many normoblasts and large phagocytic cells loaded with hemosiderin. Bile is very dark and viscous. Bone marrow of femur is very hyperplastic and contains numerous pigment-holding phagocytes.

Note that the marked fragmentation of red cells and the increased number of erythroblasts in the circulating blood on the 16th day is followed by a very rapid blood destruction and the appearance of icterus.

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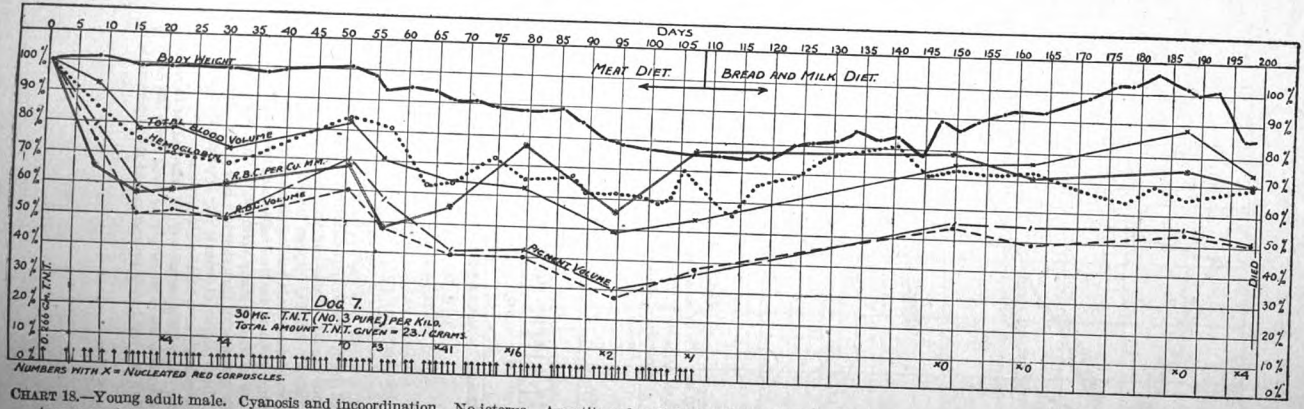

CHART 18.—Young adult male. Cyanosis and incoordination. No icterus. Appetite reduced during the period of acute intoxication at the beginning of the experiment, followed by a temporary increase in food consumption. Leucocytes varied from 6,400 to 23,400. See Table 18 for individual counts and differential counts. Reticulated reds varied from 37 to 110 between the 22d and 108th days. Nucleated reds varied from none to 41 between 22d and 199th days. Anisocytosis and basophilia.

Autopsy.—No icterus. Extensive superficial ulceration of oral mucous membrane. Mucous membrane comes away in long shreds. Bone marrow hyperplastic. No increased pigmentation of spleen, liver, or bone marrow.

On the 109th day T. N. T. was discontinued and the diet was changed to bread and milk. During the next 92 days there was little blood regeneration and finally the animal died as a result of the deficient diet.

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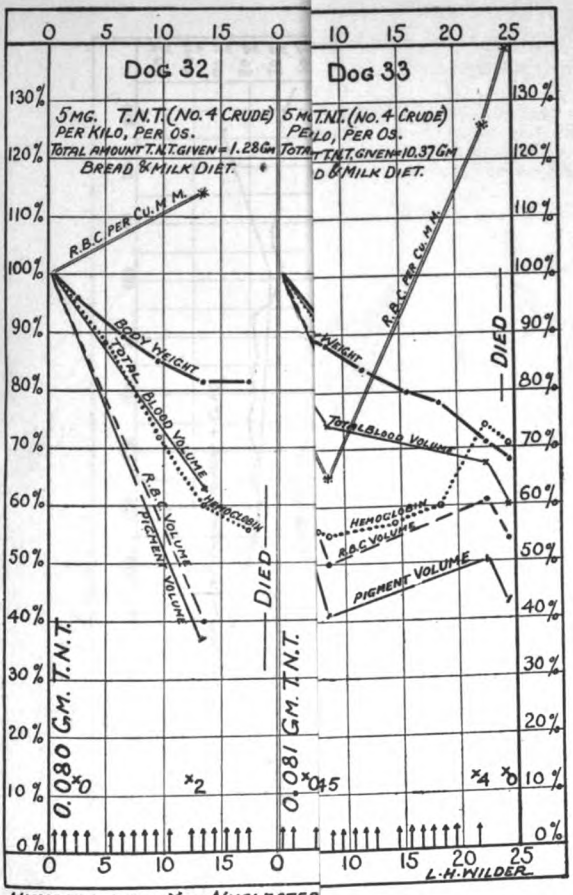

CHART 20.—Dog 32: Young adult male. No unt from 7,800 to 16,200. See Table 20 for individual counts and differential cilia. Animal died of a gas bacillus infection on the 20th day following a voca

Note that the rapid blood destruction preceded th

Dog 47: Adult male. Marked incoordination 21 for individual counts and differential counts. Reticulated reds from 1 to 3.

Autopsy.—No icterus. Extensive superficial plete occlusion of the branch leading to the middle lobe of right lung. Infarct in hemosiderin-holding phagocytes.

Dog 25: Young adult female. Slight cyanosis See Table 22 for individual counts and differential counts. Reticulated reds

Autopsy.—No icterus. Liver shows a few sma lightly enlarged. The pulp contains many normoblasts and hemosiderin-holdi

Dog 20: Adult female. Slight cyanosis, sali 17,700. See Table 23 for individual counts and differential counts. Reticulat

Autopsy.—No icterus. Extensive superficial ith phagocytes loaded with hemosiderin. Liver capillaries contain pigmen

Dog 33: Young adult female. Slight cyanosis; tite. Leucocytes varied from 14,100 to 18,200. See Table 24 for individual cou poikilocytosis, and basophilia.

Autopsy.—Oral mucous membrane intact. Bagocytes loaded with coarsely granular hemosiderin. Myeline degeneration of

Note the rapidity and extent of the blood destructi

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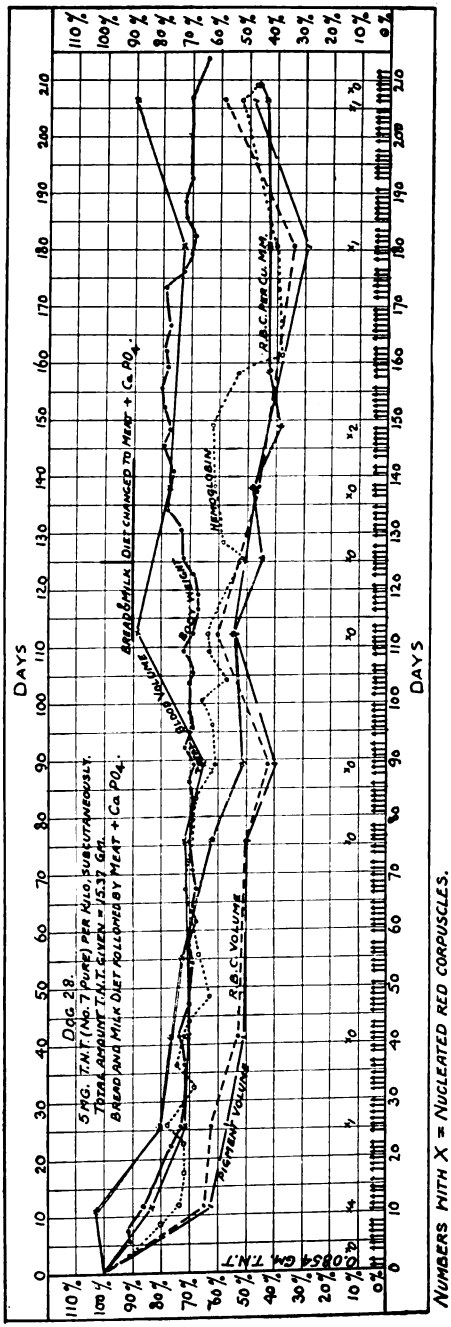
DAYS
5 MG. T.N.T. (No. 7 PURE) PER KILO SUBCUTANEOUSLY.
TOTAL AMOUNT T.N.T. GIVEN = 15.37 GM.
BREAD AND MILK DIET FOLLOWED BY MEAT + Ca PO4.
DOG 28.
BREAD & MILK DIET CHANGED TO MEAT + Ca PO4.
BLOOD VOLUME
BODY WEIGHT
HEMOGLOBIN
R.B.C. PER CU. MM.
R.B.C. VOLUME
MEAT VOLUME
0.0854 GM. T.N.T.
DAYS

Numbers with X = Nucleated red corpuscles.

Chart 21.—Adult female. Slight cyanosis, salivation, and incoordination. No icterus. Deficient food consumption. Leucocytes varied from 6,400 to 23,600. See Table 25 for the individual counts and differential counts. Reticulated red cells from 2 to 14 during first 42 days. Nucleated reds from none to 4. Anisocytosis.

Autopsy.—Negative.

Note the marked resistance of dogs 28, 15, and 17 to T. N. T. on the deficient diet of bread and milk. See also Charts 22 and 23.

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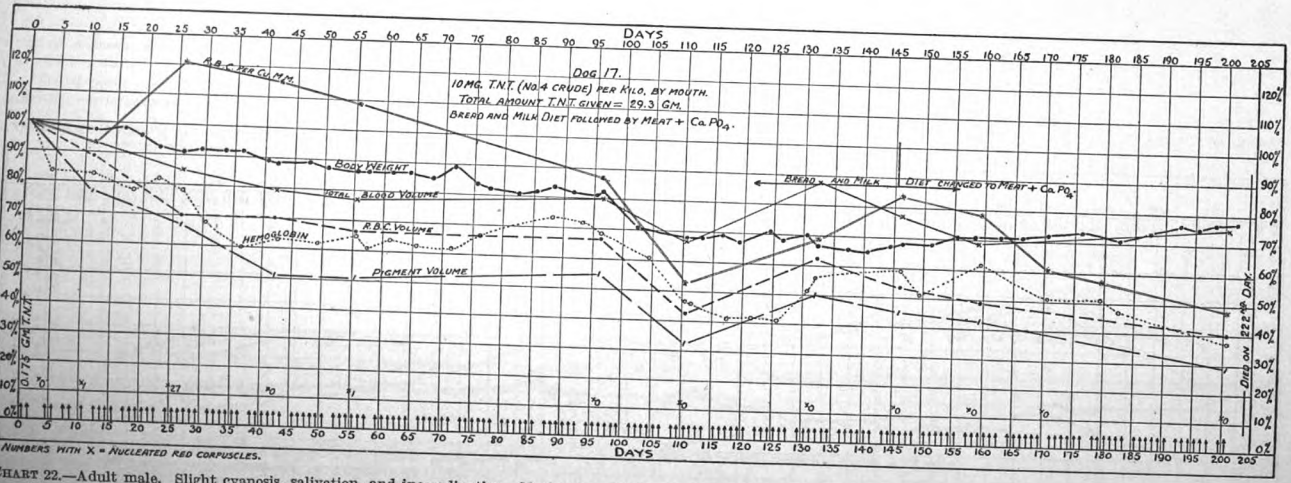
DOG 17.
10 MG. T.N.T. (No. 4 CRUDE) PER KILO. BY MOUTH.
TOTAL AMOUNT T.N.T. GIVEN = 29.3 GM.
BREAD AND MILK DIET FOLLOWED BY MEAT + $CaPO_3$.
DAYS
A.B.C. PER CU. MM.
BODY WEIGHT
TOTAL BLOOD VOLUME
R.B.C. VOLUME
HEMOGLOBIN
PIGMENT VOLUME
BREAD AND MILK
DIET CHANGED TO MEAT + $CaPO_3$
DIED ON 222ND DAY.
0.175 GM. T.N.T.
NUMBERS WITH X = NUCLEATED RED CORPUSCLES.

CHART 22.—Adult male. Slight cyanosis, salivation, and incoordination. No icterus. Gradual loss of appetite. Superficial ulceration of oral mucous membrane between 53d and 58th days and also between the 102d and 107th days. Leucocytes varied from 7,700 to 28,200. See Table 26 for individual and differential counts. Reticulated cells varied from 4 to 25 during the first 56 days. Nucleated reds from none to 27. Marked anisocytosis and basophilia.

Autopsy.—Emaciation, acute nephritis. Bone marrow hyperplastic.

Note the fragmentation of red corpuscles, especially between the 27th and 56th days.

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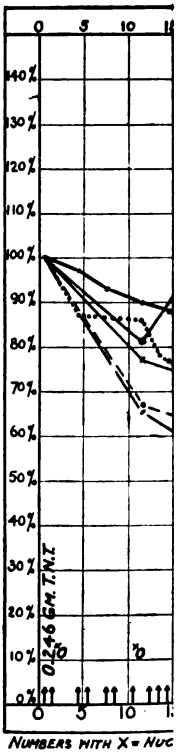

NUMBERS WITH X = NUC

CHART 23.—Adult male.
and 65th day and b
22,400. See Table 2
7. Anisocytosis and
Autopsy.—Emaciation.
bone marrow, and n
Note the increased fragme
187283—20°. (T

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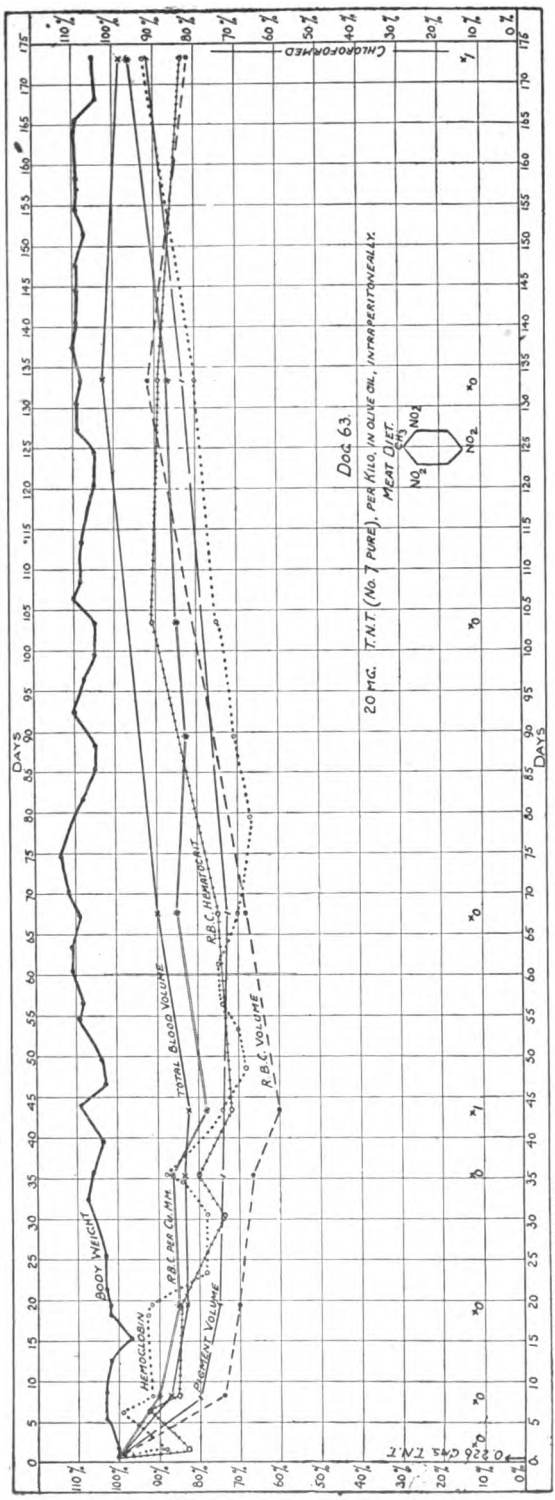

CHART 24.—This experiment illustrates the effect of a single dose of T. N. T. (20 mg. per kilo, body weight) followed by a moderate anemia without any other noticeable symptoms. No increase in erythroblasts was noted at any time during this experiment. Animal was killed with chloroform on the 176th day. *Autopsy.*—Negative. See Table 28.

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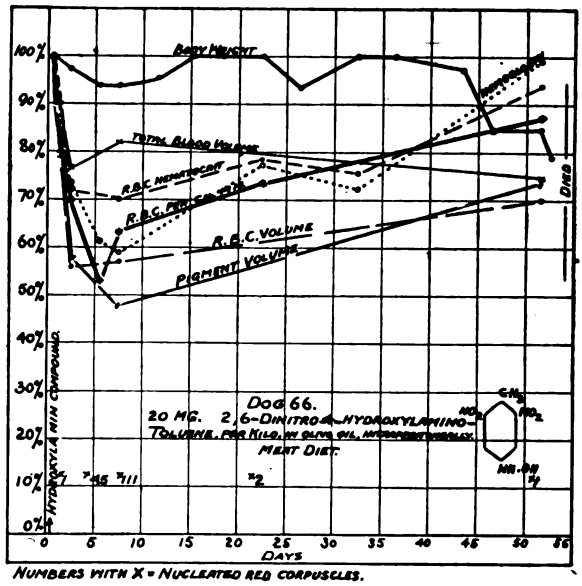
CHART 25.



NUMBERS WITH X = NUCLEATED RED CORPUSCLES.

CHARTS 25 AND 26.—The effect of a single dose of 2, 6-dinitro-4-hydroxylamino-toluene (20 mg. per kilo, body weight). Intense cyanosis developed within two hours and disappeared the following day. An acute anemia of moderate severity ensued in both animals in the absence of bilirubinuria, hemoglobinuria, and hemoglobinemia. A positive Webster's urinary test was obtained in dog 66. A large amount of methemoglobin was found in the blood of dog 58 during the period of cyanosis.

Note the tremendous increase in the erythroblast in the blood of dog 66, followed by rapid blood regeneration with considerable anisocytosis and poikilocytosis. In contradistinction dog 58 showed only a few erythroblasts and no blood regeneration. Dog 58 developed distemper on the 24th day and died the following day. Dog 66 died on the 55d day. Both autopsies were practically negative. See Tables 29 and 30.

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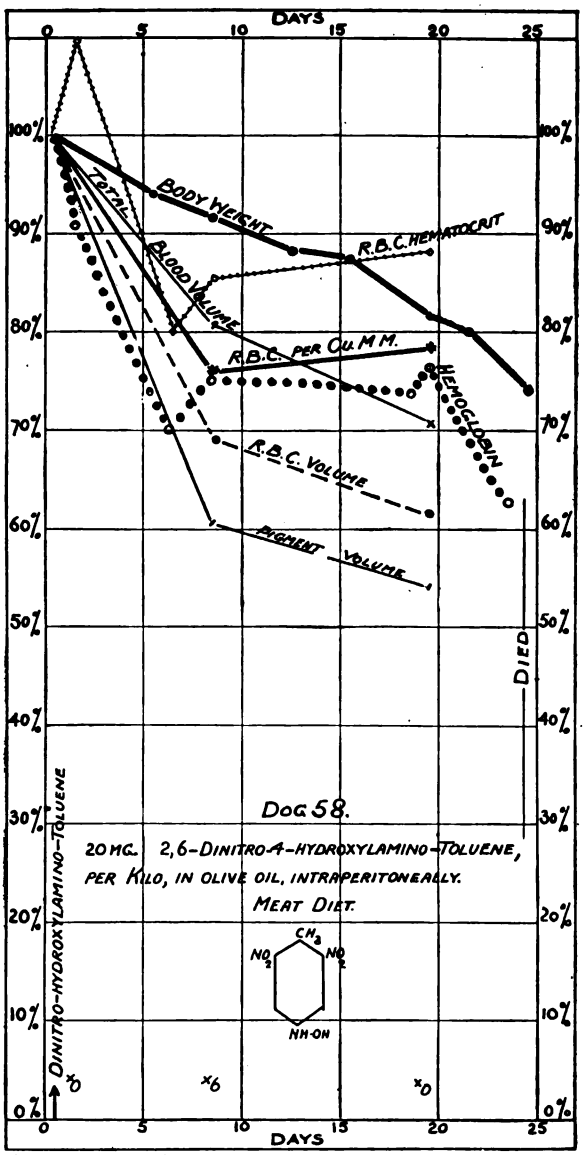
CHART 26.



NUMBERS WITH X = NUCLEATED RED CORPUSCLES.

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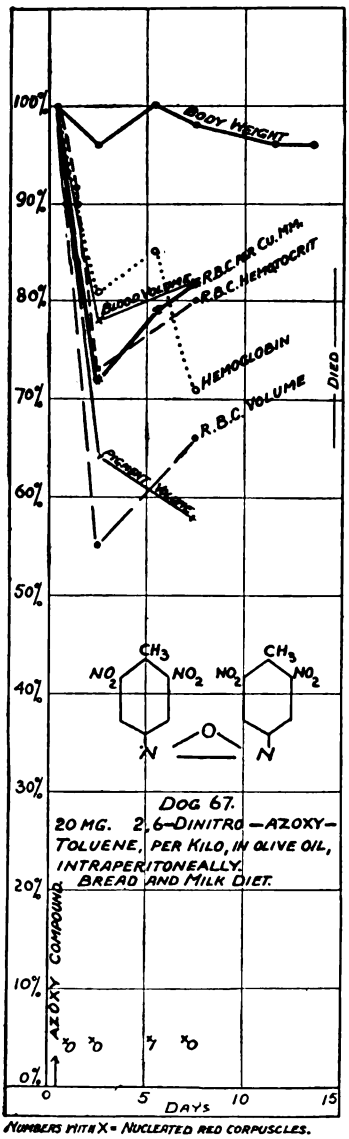

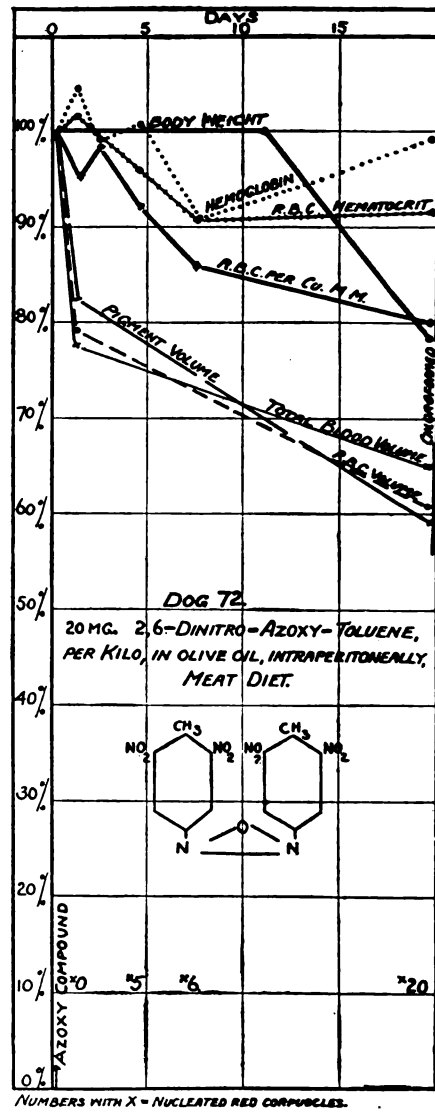

CHARTS 27 and 28.—Illustrate the production of a moderate anæmia after the administration of 2, 6-dinitro-azoxy-toluene. See Tables 31 and 32.

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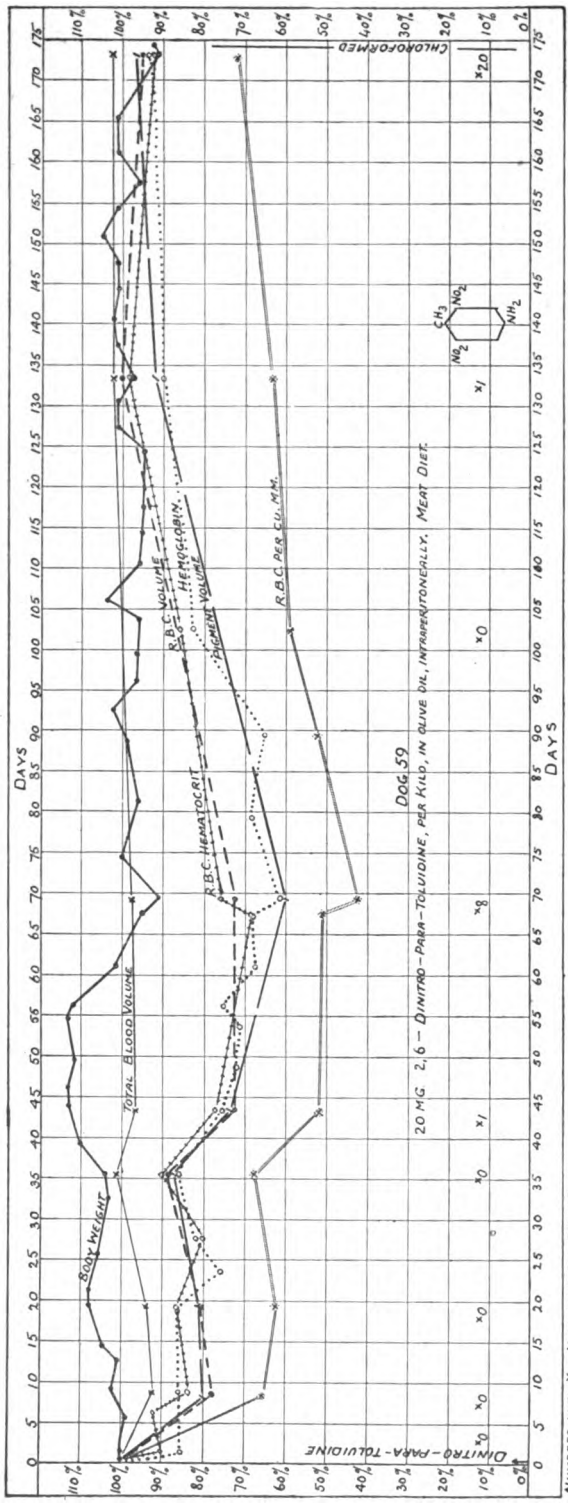

CHART 29.—Illustrates the effect of a single dose of 2, 6-dinitro-para-toluidine, as shown by the gradual appearance of a moderate anæmia. The animal gave birth to five normal puppies on the 62d day, and from this time on the curve of blood regeneration was progressive. See Table 33.

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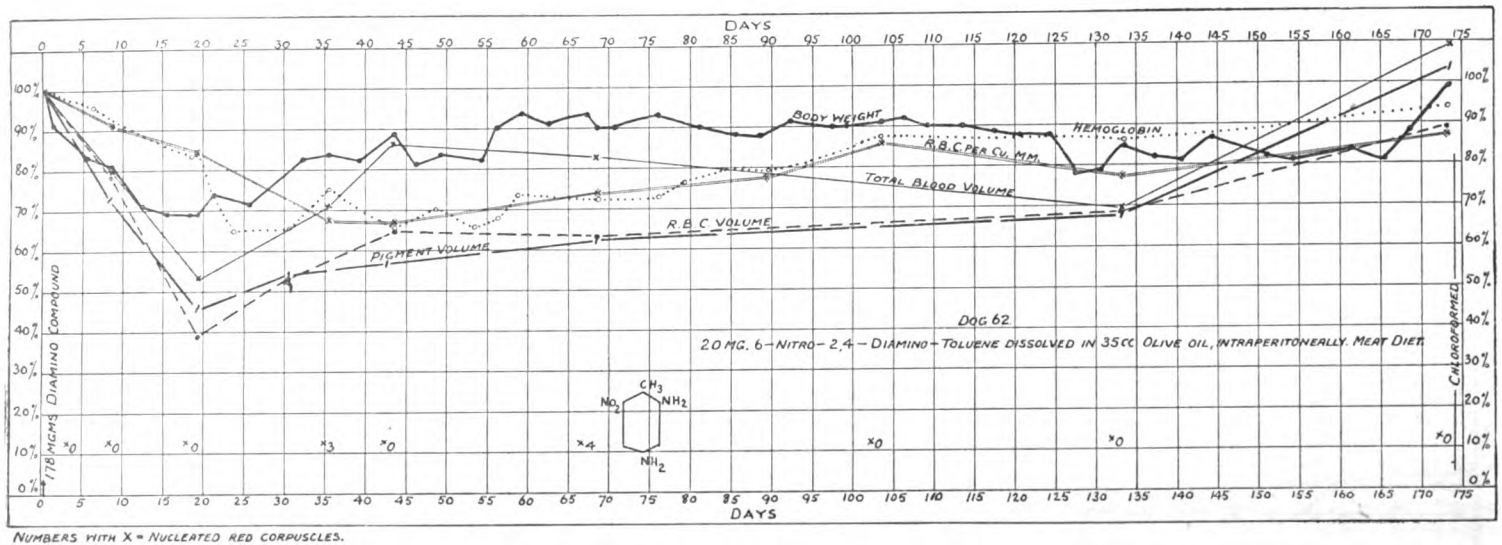

NUMBERS WITH X = NUCLEATED RED CORPUSCLES.

CHART 30.—Illustrates a marked anæmia produced by a moderate dose of 6-nitro-2, 4-diamino-toluene, followed by complete recovery. The dog showed pronounced cyanosis and the blood contained methemoglobin on the first day. See Table 34.

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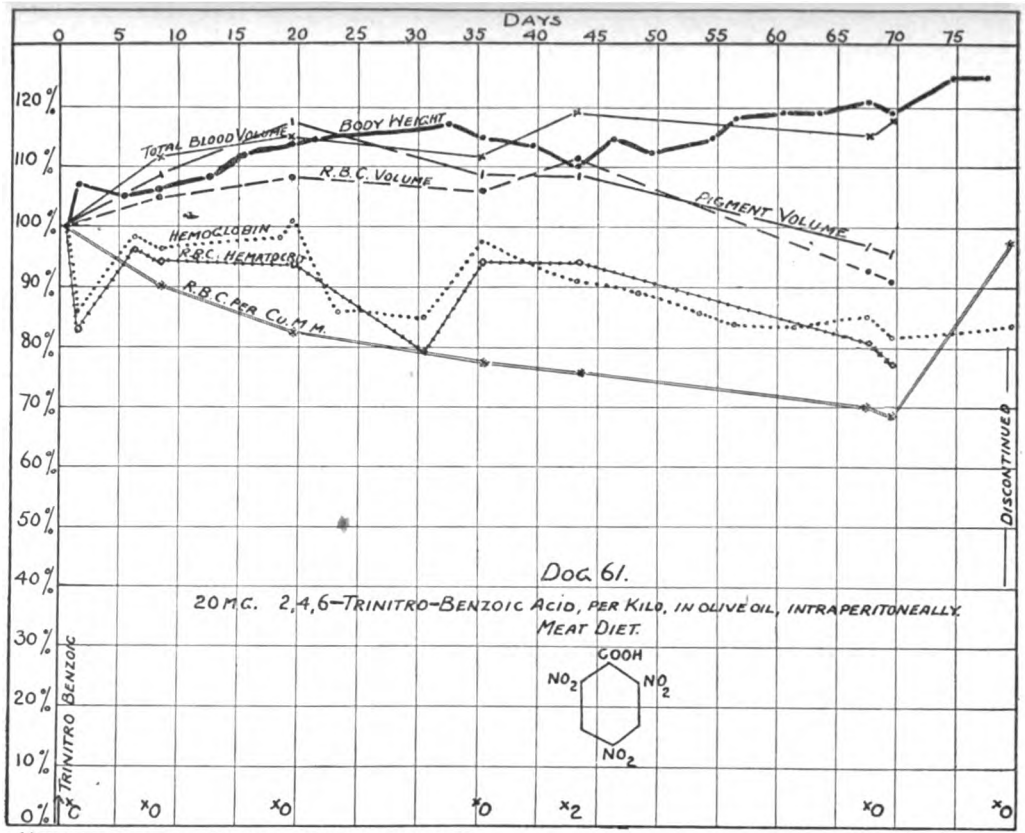

CHART 31.—A single dose of 2, 4, 6-trinitro-benzoic acid was followed by no appreciable change in the blood picture. The pigment volume remained normal throughout the experiment. On the first day of the experiment the urine gave evidence of the excretion of the substance as indicated by the Webster's reaction. See Table 35.

Note that this oxidation product of T. N. T. caused no anæmia, whereas all the reduction products so far tested led to marked blood destruction of the same character as that produced by T. N. T.

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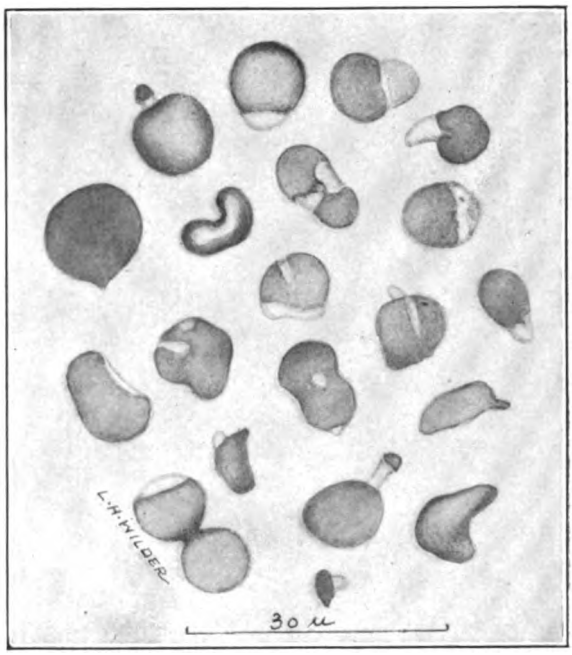

FIG. 1.—DISINTEGRATING RED CORPUSCLES FROM THE BLOOD OF AN ACUTELY POISONED T. N. T. DOG. WRIGHT'S STAIN.

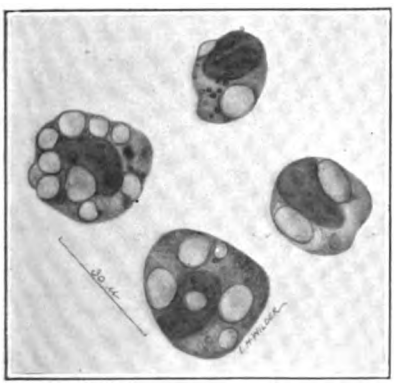

FIG. 2.—MONONUCLEAR PHAGOCYTES WITH ENGULFED RED CELLS FROM THE SPLEEN PULP IN ACUTE POISONING.

FIG. 3.—KUPFFER CELLS CONTAINING RED CELLS AND PIGMENT FROM THE LIVER CAPILLARIES IN ACUTE POISONING.

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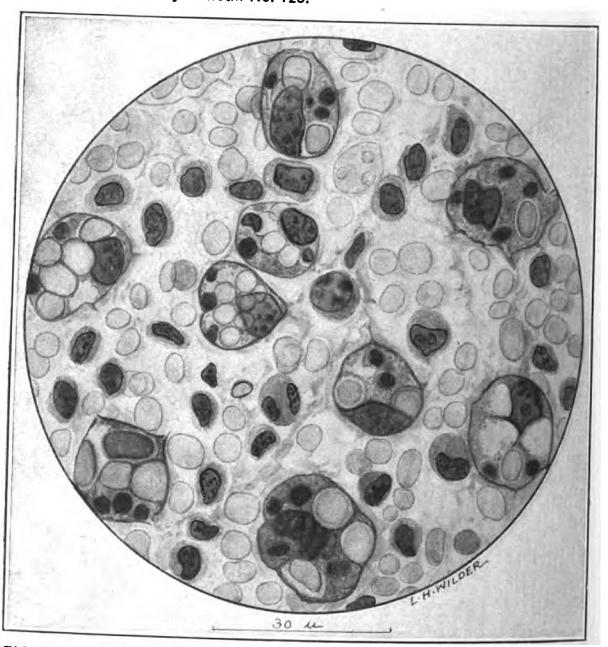

FIG. 4.—SPLEEN PULP IN ACUTE POISONING AFTER PERFUSING WITH GELATIN-LOCKE'S-CITRATE SOLUTION. NOTE THE NUMEROUS MONONUCLEAR PHAGOCYTES WITH ENGULFED RED CELLS. HEMATOXYLIN AND EOSIN.

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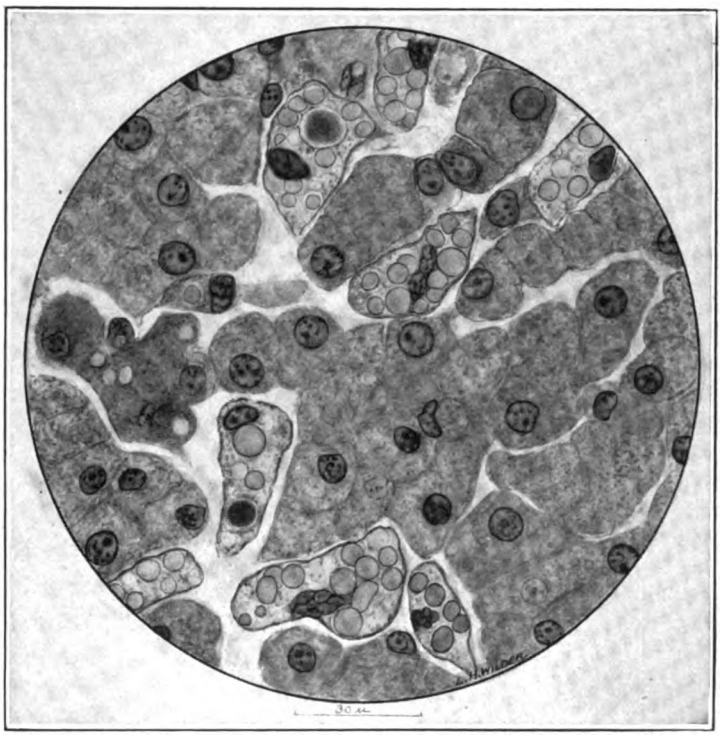

FIG. 5.—LIVER IN ACUTE POISONING AFTER PERFUSION. THE CAPILLARIES CONTAIN MANY SWOLLEN AND DETACHED KUPFFER CELLS WITH ENGULFED RED CELLS AND HEMOSIDERIN. HEMATOXYLIN AND EOSIN.

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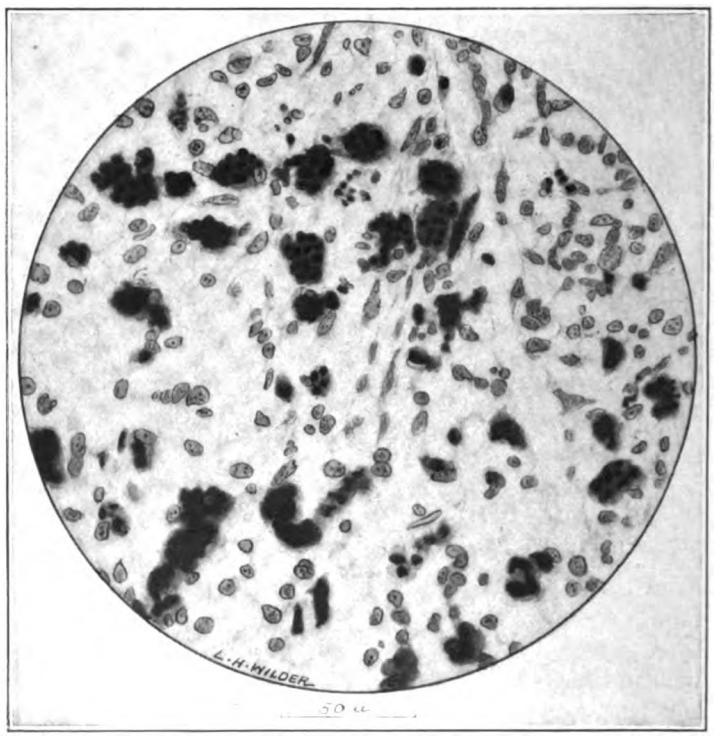

FIG. 6.—SPLEEN PULP IN CHRONIC POISONING CONTAINING A MAXIMUM AMOUNT OF HEMOSIDERIN. PERL'S REACTION.

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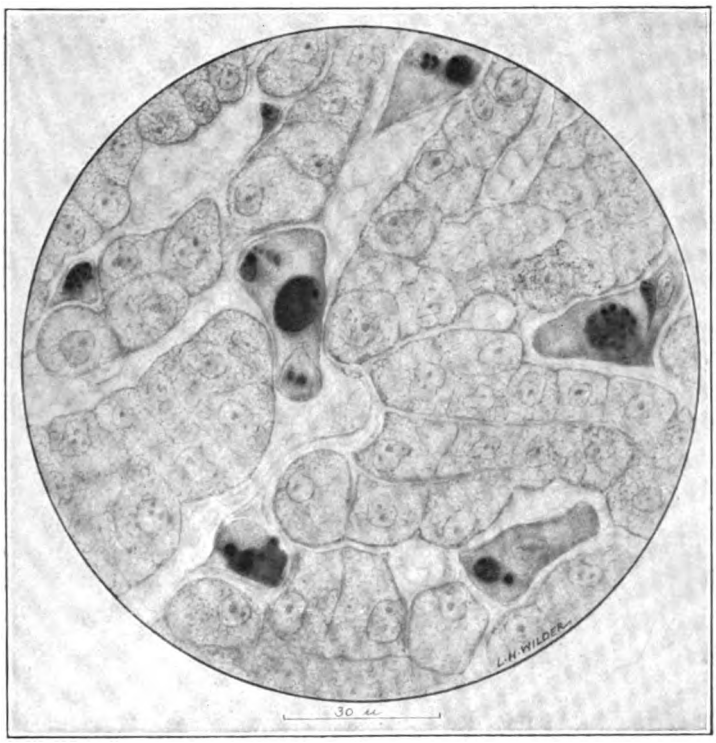

FIG. 7.—LIVER IN CHRONIC POISONING SHOWING THE HEMOSIDERIN IN THE SWOLLEN KUPFFER CELLS WITHIN THE LIVER CAPILLARIES. THE LIVER CELLS DO NOT CONTAIN HEMOSIDERIN. PERL'S REACTION.

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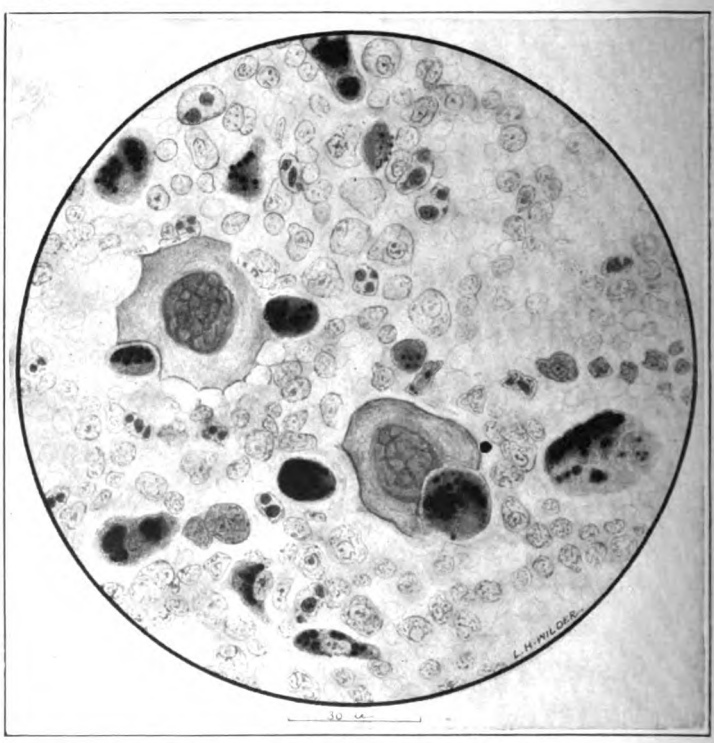

FIG. 8.—BONE MARROW IN CHRONIC POISONING. NOTE THE AMOUNT OF HEMOSIDERIN WITHIN THE PHAGOCYTIC CELLS. PERL'S REACTION.

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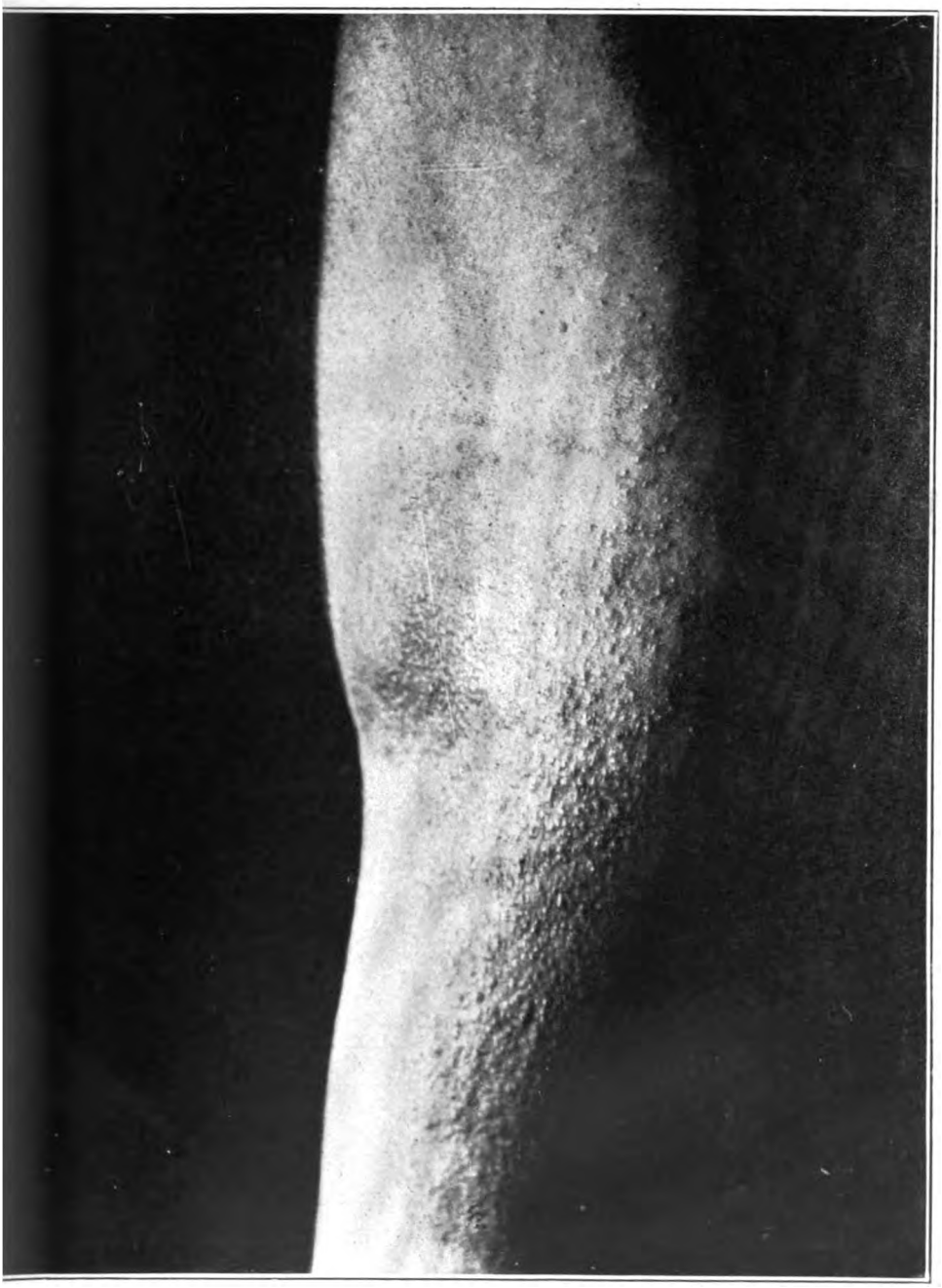

FIG. 9.—DERMATITIS PRODUCED BY T. N. T.

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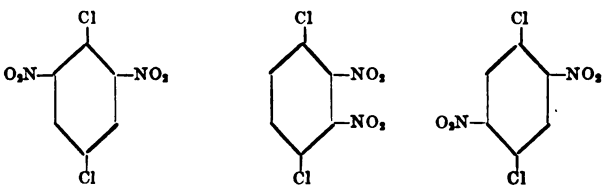
II. THE TOXIC ACTION OF "PARAZOL" (CRUDE DICHLORDINITROBENZENE).

By CARL VOEGTLIN, A. E. LIVINGSTON, and C. W. HOOPER.[1]

During the latter part of the war so-called "parazol" came into extensive use as a high explosive. It was soon realized that its handling involves certain dangers, inasmuch as it causes a severe dermatitis. The work to be reported in this paper was undertaken at the request of the Navy Department principally for the purpose of devising some means for the prevention of the skin lesions. In addition, the systemic effects produced by the substance were also studied.

1. PHYSICAL PROPERTIES AND CHEMICAL COMPOSITION OF PARAZOL.

Parazol is obtained by the nitration of paradichlorobenzene. It consists of a coarse, sticky, yellow powder, somewhat granular in character, possessing a pungent odor and melting between 60° and 80° C. It is almost insoluble in water, but dissolves very readily in olive oil and most organic solvents. Parazol is not a chemical entity, but represents essentially a mixture of three isomers of the following constitution:



The first two isomers were isolated in pure form from the crude substance by Joseph K. Marcus of this laboratory, and the isolation of the third isomer was reported by Edith H. Nason[2] during the progress of this work.

Dr. Marcus furthermore separated a small fraction, which consisted of paranitrochlorbenzene.

2. REPORT ON THE CHEMICAL COMPOSITION OF "PARAZOL" BY JOSEPH K. MARCUS.

The isolation of metadinitro-paradichlorobenzene from parazol.—Four hundred and fifty grams of parazol was recrystallized twice from three liter portions of alcohol and then twice again from one

[1] Submitted for publication March, 1920. [2] Jour. Am. Chem. Soc., 1918, vol. 40, p. 1602.

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liter of alcohol. The 110 grams of product thus obtained melted at 80°–85° and was a mixture. This is at variance with the statement made by Nason that the 104° compound is easily separated from its two isomers by means of alcohol. It was then treated with 200 c. c. of warm ether and the warm ether decanted off. After another treatment of the residue with 100 c. c. ether, it was dissolved in 250 c. c. hot alcohol containing 50 c. c. ether, and on cooling homogeneous plates came down. At a certain stage where small crystals began to deposit the liquid was decanted off and the remaining solid was crystallized from gasoline. Large pale greenish-yellow plates were obtained, melting point 105.5°–106.5° (corr.). Yield, 9 grams. This quantity, of course, represents only a fraction of the total amount of this isomer which the original sample of parazol contained.

Calculated for $C_6H_2(NO_2)_2Cl_2$: C, 30.4; H, 0.84; N, 11.8.
Found C, 30.3; H, 0.96; N, 11.9.

The compound gives an intense red color when heated in alcohol with a few drops of potassium cyanide solution, which forms a means of distinguishing it from orthodinitro-paradichlorobenzene and paranitro-chlorobenzene (q. v.).

In alcohol with a few drops of ammonium sulphide solution, the compound gives a dark reddish-brown color (distinction from the other two compounds (q. v.)).

In acetone, with a few drops of aqueous sodium hydroxide, it gives an intense cherry red color (distinction from the other two compounds (q. v.)).[3]

A small quantity of metadinitro-paradichlorobenzene in alcohol was reduced with an excess of stannous chloride, the resulting solution was treated with sodium carbonate solution, and the mixture so obtained was extracted with ether. No pure compound could be isolated, but the ether solution on evaporation to dryness left a residue which, on being taken up with dilute hydrochloric acid and treated with sodium nitrite solution gave a deep brown color. This indicated the presence of the metadiamine grouping.

Beilstein gives 104° as the melting point of metadinitro-paradichlorobenzene.

The compound is very slowly volatile with steam. Its acetone solution, when exposed to light, assumes a bright yellow color on standing.

The isolation of orthodinitro-paradichlorobenzene from parazol.— The alcoholic filtrate from the first crystallization of the 450 grams of parazol (above) was evaporated to 2 liters. A precipitate of

[3] This test originated with Dr. J. M. Johnson's observation of the red color which parazol gives with [illegible] and sodium hydroxide.

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small crystals came down, and was filtered off. The filtrate was evaporated until all the alcohol had been removed, and the dark yellow oil which remained was steam distilled to remove the para-nitro-chlorobenzene (q. v.). The residue in the distilling flask was then extracted with ether, the ether dried with sodium sulphate and then distilled off. The viscous oily residue was recrystallized from alcohol, and long thick white needles were obtained. Yield, 12 grams; melting point, 102°–103° (corr.).

Calculated for $C_6H_2(NO_2)_2Cl_2$: C, 30.4; H, 0.84; N, 11.8.
Found C, 30.4; H, 0.92; N, 12.0.

Reduction of this compound with stannous chloride solution gave an amine which melted at 99°–100° (corr.). This amine in glacial acetic acid gave a copious pale yellow precipitate on the addition of a solution of phenanthraquinone in the same solvent, which proved it to be an ortho-diamine. The melting point for 2–3 diamino-para-dichlorobenzene is given in the literature as 100°. These facts therefore bear out the configuration of the 103° isomer as given above.

The orthodinitro-paradichlorobenzene gives a light yellow color in the alcohol-potassium cyanide test, an orange color in the acetone-sodium hydroxide test, and a yellow color in the alcohol-ammonium sulphide test. It is very slowly volatile with steam. Its solubilities in the various solvents, organic and inorganic, are very similar to those of metadinitro-paradichlorobenzene.

The isolation of paranitro-chlorobenzene from parazol.—Five hundred grams of parazol were steam distilled until the oil which came over no longer solidified at the cold end of the condenser. The pale yellow crystalline solid which came over together with some oil drops melted at 73°–80°. The distillate mixture was extracted with ether, dried, the ether evaporated, and the residue fractioned in vacuo. At 30 mm., 8 grams of pale yellow crystalline solid came over between 135° and 139°, and 1 gram of a yellowish solid, from 139° to 175°. The 8-gram fraction was crystallized from alcohol and 6 grams of pale yellow needles were obtained, which melted at 83°–84° (corr.).

The compound proved to be paranitro-chlorobenzene.

Calculated for $C_6H_4Cl(NO_2)$: C, 45.7; H, 2.56; Cl, 22.6.
Found C, 45.7; H, 2.73; Cl, 21.9.

Beilstein gives 83° as the melting point for paranitro-chlorobenzene.

The configuration of the paranitro-chlorobenzene was confirmed by reducing it to para-amino-chlorobenzene:

A solution of 2.2 grams of the paranitro-chlorobenzene in alcohol was heated to boiling, and 41 c. c. of stannous chloride-hydrochloric acid (400 c. c. = 150 g. $SnCl_2.2H_2O$ + 22 g. HCl) were added thereto.

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After maintaining at 100° for one hour, the solution was poured into water and treated with excess of sodium carbonate. Without filtering, the mixture was extracted five times with ether. The ether was dried with sodium sulphate and then removed by distillation. The slightly yellow residue was crystallized twice from 15 c. c. hot ligroin (sp. gr. 0.71–0.72) and the orange solution deposited fairly large diamond shaped white prisms, melting at 70.5°–71.5° (corr.). Beilstein gives 70°–71° for the melting point of para-amino-chlorobenzene.

The compound was soluble in dilute hydrochloric acid. On diazotization with sodium nitrite and hydrochloric acid and subsequent treatment with alkaline β-naphthol solution, it gave a bright orange precipitate.

The compound gives no color in the alcohol-potassium cyanide test; a bright yellow color in the alcohol-ammonium sulphide test; and a pale yellow color in the acetone-sodium hydroxide test.

3. DERMATITIS PRODUCED BY PARAZOL AND SOME OF ITS CONSTITUENTS.

The action of parazol on the skin was mainly studied on rabbits, although a few confirmatory experiments were made with human skin. White rabbits were selected on account of the great resemblance of the skin of these animals to the human skin. The hair was removed from an area of about 2 cm. in diameter either by shaving or by the use of barium sulphide. Various quantities of the preparation to be tested, usually 50 mg., were then applied to the skin, the application being held in place by the use of a small cotton pad and adhesive tape. In some experiments it seemed desirable to allow the skin to recover from the effect of the removal of the hair before applying the substance. After various lengths of time, the pad was removed and the effect produced by the substance was noted. In addition to the crude parazol obtained from the Chemical Warfare Service, a product recrystallized several times from alcohol was also tested in order to determine whether or not the irritating properties of the crude substance might be attributed to certain impurities contained therein. Further tests were also made with 1–4 dichlor 2–6 dinitrobenzene, 1–4 dichlor 2–3 dinitrobenzene and paranitro-chlorobenzene, substances which, as has been stated, do occur in crude parazol.

The character of the dermatitis produced by these products is essentially the same in every case, but differs in its severity. When the application is removed after several hours the exposed skin shows marked thickening and some edema. A mild erythematous zone is seen at the edge of the lesion. In a few cases ulceration and abscess resulted. The hemorrhagic condition produced by mer-

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cury fulminate is not seen after the application of parazol or its constituents.

Recovery of the affected skin sometimes takes place fairly rapidly after the removal of the poison. The edema disappears within a few days and the skin is almost normal within a week after the application. The usual period of recovery, however, varies from three to four weeks.

Table 1[4] shows a comparison of the effect produced by crude and recrystallized parazol when applied to different skin areas of the same animal. The recrystallized product is more bulky than an equal weight of the crude and is confined with greater difficulty to a small area, a fact which accounts for the resulting lesions being invariably more extensive. The severity of the dermatitis is, however, of the same degree as in the case of the crude product, showing that simple recrystallization does not remove the injurious substance.

It is furthermore seen from Table 1 that the crude product causes more severe lesions than any of its constituents. Substance A is considerably more injurious than Substance C, this representing, therefore, another example of the difference in physiological action of chemical isomers.

It should also be noted that the severity of the reaction increases with the time of exposure, a short exposure (three hours) sometimes producing only a slight effect or no effect at all.

When the skin is shaved and a day or more allowed to intervene before the substance is applied, the effect produced is less marked. This is probably due to the fact that even the most careful shaving damages the epidermis to such an extent that absorption of the substance takes place more readily.

4. EYE LESIONS PRODUCED BY PARAZOL AND ITS CONSTITUENTS.

Twenty-eight experiments were made on the conjunctivae of rabbits for the purpose of studying the action on the eyes of parazol, and the other substances under consideration. When the products are applied as a 1 per cent solution in olive oil no effect is produced. If, however, a small particle of the dry powder is inserted into the conjunctival sac a marked conjunctivitis results. After several days a purulent discharge may be seen. It is thought improbable that the conjunctivitis is due to mechanical irritation, as the intensity of the reaction produced by the different products varies in the same way as in the case of the skin lesions. As a matter of fact, the crude parazol which, on account of its physical (waxy) properties might be expected to produce the least mechanical irritation, was the most effective.

[4] L. D. and R. D. indicate that the substance was applied to the left or right dorsal area respectively. The intensity of the reaction produced is proportional to the number of + signs. A – sign means that no lesion was produced.

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Through an accident, one of the writers carried a trace of parazol into his eye, with the result that the eye began to smart severely within a few minutes.

For the protection of the eyes of the workers, we recommend that the manipulation of parazol should be carried out in such a way as to prevent the slightest air contamination with the substance, and that in addition the workers should be provided with suitable goggles.

5. SYSTEMIC EFFECTS OF CRUDE PARAZOL.

In view of the fact that parazol represents a mixture of aromatic nitro compounds, it was to be expected that absorption of the substance might produce definite systemic changes, particularly changes in the composition of the blood. For the detection of these changes the same methods were used as those described in the preceding paper on T. N. T. poisoning. The substance was given in single doses by mouth or subcutaneously as a 20 per cent solution in olive oil. No attempt was made to produce chronic poisoning. The results obtained in these experiments are illustrated in Charts 1, 2, and 3, and Tables 3 to 6, inclusive, and are briefly as follows:

The subcutaneous injection of parazol causes a very severe local reaction characterized by an extensive edema and induration, and finally leads in some cases to the formation of a sterile abscess which may break open and become infected secondarily. On the contrary, when given by mouth, parazol is absorbed without causing any gastro-intestinal irritation. Like T. N. T., parazol produces a marked anemia, this being characterized by a decrease of the hemoglobin content of the blood and the total blood volume, a decrease in the number of red blood cells, anisocytosis and basophilia, and the appearance of a large number of nucleated red cells in the circulating blood. Recovery from the anemia takes place rather slowly. Cyanosis and incoordination were never observed. The urine often contains an increased amount of bile pigment but the presence of icterus was never noted. During the first few days after the parazol is given, the urine assumes a dark orange color. No indication of renal irritation was obtained. The organs of the few animals which were examined microscopically showed evidence of increased pigmentation (hemosiderin) in the spleen and liver of the same type as found in T. N. T. poisoning.

Attention is called to the fact that relatively large amounts of parazol are required to produce a marked anemia, and that even with these large doses other systemic symptoms are lacking. Apart from the intense effect on the skin and conjunctivae, parazol may therefore be considered as a low grade poison, an assumption which receives further support by the fact that no reports of any systemic poisoning among parazol workers have ever come to our attention.

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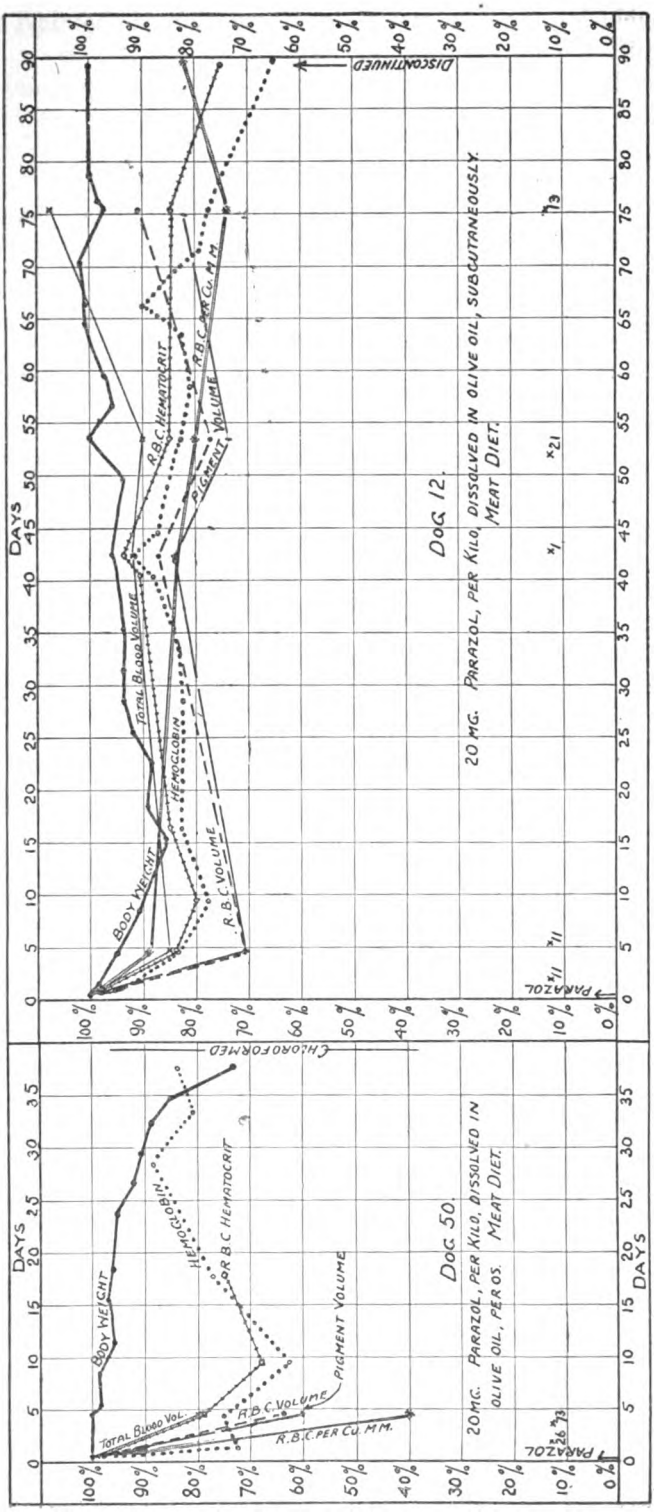
CHART 1



NUMBERS WITH X = NUCLEATED RED CORPUSCLES.

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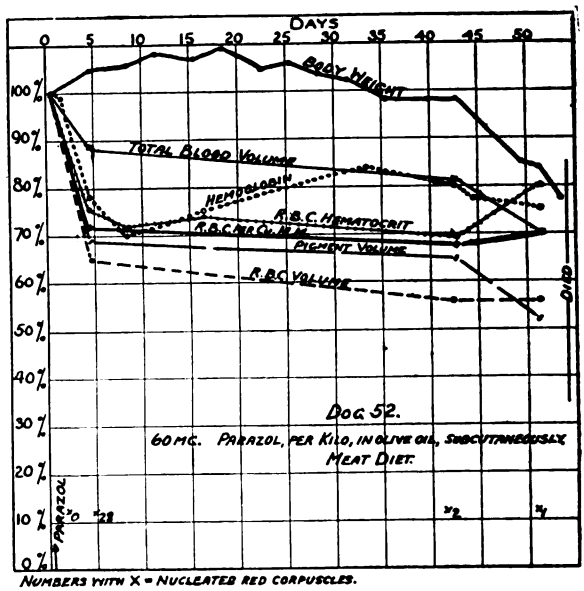
In conclusion, a few remarks on the relation of chemical constitution to physiological action as brought out by this work may not be devoid of interest. Parazol is a mixture of chlorinated and nitrated aromatic compounds. The cause of the anemia produced by the substance is very probably largely due to the nitro groups which, as in the case of trinitrotoluene, are probably reduced within the body. The dermatitis and conjunctivitis, on the other hand, depend very largely, if not altogether, on the presence of chlorine in the molecule. The substance being easily fat soluble, probably penetrates the skin by way of the hair follicles, and is absorbed by the cells of the skin where it then exerts its toxic action. Whether this action depends on a hydrolytic cleavage leading to the intra-cellular production of free

CHART 2



hydrochloric acid, as described by Lynch, Smith, and Marshall[5] in the case of mustard gas, remains to be determined. This possibility is not ruled out, although it is not so easy to conceive such an hydrolysis in view of the fact that the chlorine is very firmly bound in parazol, whereas mustard gas is easily hydrolyzed on coming in contact with water.

SUMMARY.

Parazol, or crude dichlordinitrobenzene, produces a severe dermatitis and conjunctivitis. The production of the skin lesions is governed to some extent by the condition of the skin at the time of the application of the substance. If the epidermis is intact the

[5] Jr. Pharm. and exp. Ther., 1918. Vol. 12, p. 265.

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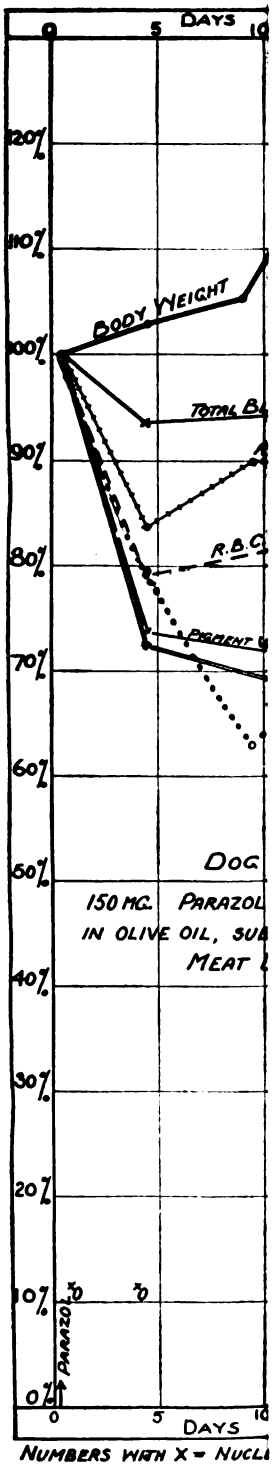

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lesions are invariably less severe than when the skin is slightly injured by shaving. Three constituents of parazol were isolated in chemically pure form and were found to exert the same injurious action on the skin, although somewhat less pronounced than that of the crude product.

The systemic action of parazol consists principally in the production of a secondary anemia very similar in character to that produced by trinitrotoluene.

In regard to the prevention of the dermatitis and conjunctivitis, clean working conditions, substitution of machinery for manual labor, and prevention of air contamination are probably the most effective means.

Experiments made with various skin varnishes proved them to be unreliable as a protective measure. It might be suggested that gloves and proper clothing, which completely cover the body surface, should be worn by all workers. Suitable goggles may prove effective against the eye lesions.

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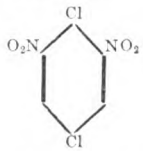
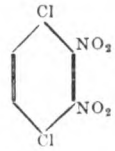
TABLE 1.

No. of animal.	Hours intervening between removal of hair and application of substance.	Crude parazol.				Recrystallized parazol.				Substance A. 				Substance B.				Substance C. 			
		Milligrams applied to skin.	Skin region exposed.	Time of exposure in hours.	Intensity of reaction.	Milligrams applied to skin.	Skin region exposed.	Time of exposure in hours.	Intensity of reaction.	Milligrams applied to skin.	Skin region exposed.	Time of exposure in hours.	Intensity of reaction.	Milligrams applied to skin.	Skin region exposed.	Time of exposure in hours.	Intensity of reaction.	Milligrams applied to skin.	Skin region exposed.	Time of exposure in hours.	Intensity of reaction.
5....	2	50	L. D.	18	++++	50	R. D.	18	++++	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
6....	2	50	L. D.	18	++++	50	R. D.	18	++++	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
9....	2	50	L. D.	6	+	50	R. D.	6	+	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
9....	2	50	L. D.	23	++++	50	R. D.	23	++++	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
10....	2	50	L. D.	22	++++	50	R. D.	22	++++	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
35....	24	50	L. D.	27	++	50	R. D.	27	++	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
36....	24	50	L. D.	27	++	50	R. D.	27	++	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
13....	24	50	L. D.	24	+++	.....	.....	.....	.....	50	R. D.	24	++	.....	.....	.....	.....	.....	.....	.....	.....
14....	24	50	L. D.	24	++	.....	.....	.....	.....	50	R. D.	20	+	.....	.....	.....	.....	.....	.....	.....	.....
29....	24	50	L. D.	20	+++	.....	.....	.....	.....	50	R. D.	20	++	.....	.....	.....	.....	.....	.....	.....	.....
30....	24	50	L. D.	20	+++	.....	.....	.....	.....	50	R. D.	20	++	.....	.....	.....	.....	.....	.....	.....	.....
15....	48	50	L. D.	22	++	.....	.....	.....	.....	.....	.....	.....	.....	50	R. D.	22	+	.....	.....	.....	.....
16....	48	50	L. D.	23	++	.....	.....	.....	.....	.....	.....	.....	.....	50	R. D.	23	+	.....	.....	.....	.....
33....	24	50	L. D.	28	+++	.....	.....	.....	.....	.....	.....	.....	.....	50	R. D.	28	+	.....	.....	.....	.....
34....	24	50	L. D.	28	+++	.....	.....	.....	.....	.....	.....	.....	.....	50	R. D.	28	+	.....	.....	.....	.....
11....	2	50	L. D.	5	++	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	50	R. D.	5	+
11....	2	50	L. D.	22	++++	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	50	R. D.	22	+
12....	24	50	L. D.	5	+	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	50	R. D.	5	−
12....	24	50	L. D.	22	+++	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	50	R. D.	22	−
31....	24	50	L. D.	20	+++	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	50	R. D.	20	+
32....	24	50	L. D.	20	+++	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	50	R. D.	20	+

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1	24										20	L. D.	3	−					20	R. D.	3	−
1	24										20	L. D.	20	++					20	R. D.	20	++
1	24										50	L. D.	48	++					50	R. D.	48	++
2	24										20	L. D.	3	−					20	R. D.	3	−
2	24										20	L. D.	20	−					20	R. D.	20	−
2	24										50	L. D.	19	++					50	R. D.	19	++
3	24										50	L. D.	18	++					50	R. D.	18	+
4	24										50	L. D.	18	++	50	R. D.	18	−				
56	1										50	L. D.	28	++	50	R. D.	28	+				
57	1										50	L. D.	28	++	50	R. D.	28	+				
58	24										50	L. D.	24	+	50	R. D.	24	−				
59	24										50	L. D.	24	++	50	R. D.	24	+				

TABLE 2.

[20 mg. parazol, per kilo, in olive oil, per os.]

DOG 50.

[Meat diet.]

Day of experiment.	Time.	Food eaten daily.	Body weight.	Clinical symptoms.		Urine.			Feces.	Remarks.
				Character of mucous membranes.	Incoordination.	Color.	Albumin.	Bile pigment.		
	A. M.	*Gms.*	*Kilos.*							
1	9.00	.....	9.3	Normal	None	Yellow, cloudy	None	+ Slight	.....	Old fox terrier, mongrel, bitch. 186 mg. parazol, per os, in olive oil, 20 per cent solution.
	P. M.									
	12.30	.....	.....	Normal	None	Red, cloudy	.....	+	.....	Urine: No hemoglobin bands in spectrum.
	4.30	205	.....	do	...do	Red	None	.....	Soft	Droopy.
2–16	.....	300	9	Pale pink	...do	Opaque yellow	+ Slight	None	Hard	
17–23	.....	275	8.8	...do	...do	Light brown	.....	+ Slight	Soft	Conjunctivæ congested.
24–26	.....	255	8.4	...do	...do	.....	.....	+	Hard	Slight coughing.
27–30	.....	275	8.3	...do	...do	Yellow	.....	None	...do	Distemper.
31–34	.....	300	8.1	...do	...do	Brown	.....	+	...do	
36	.....	300	7.8	...do	.....	.....	.....	.....	.....	Nervous type of distemper.
37	.....	0	.....	...do	.....	.....	.....	.....	Hard	
38	.....	.....	6.7	.....	.....	.....	.....	.....	.....	2 p. m. moribund. Killed with chloroform.

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TABLE 2—Continued.

DOG 50—Continued.

Day of experiment.	Time.	Hb.	Red cells per c. mm.	White cells per c. mm.	Differential count.					Nucleated reds.	Character of reds.	Blood volume.		Plasma.			Methb.	Clot.
					Small monos.	Large monos.	Pmn. n.	Pmn. eos.	Tr.			Plasma.	Total.	Character.	Per cent.	Hemolysis.		
	A. M.	*P. ct.*			*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*			c. c.	c. c.					
1	9.00	97	12,464,000	13,400	16	4	76	3	1	26	Anisocytosis and slight basophilia.	380	808	Amber, clear.....	47	None..	None..	Firm.
	P. M.																	
	12.30	89	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	..do.[1]..	
	4.30	78	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Amber, clear.....	57	.....	...do..	
2	.....	71	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	...do..	
5	.....	73	4,976,000	27,000	7	1	86	4	2	73	Anisocytosis and slight basophilia.	377	650	Amber, clear.....	58	None..	...do..	Do.
10	.....	61	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Lipaemia ++.....	64	...do..	...do..	Do.
18	.....	75	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Lipaemia +++.....	60	...do..	...do..	Do.
29	.....	85	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
34	.....	79	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
38	.....	81	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	

[1] Blood very dark. Diffuse darkening of green, blue, violet end of spectrum.

October 2, 1918.—Autopsy.—Dog is emaciated. Nostrils are covered with a dry brownish-yellow exudate. Conjunctivæ are covered with a purulent exudate. Oral mucous membrane is intact. No icterus. Subcutaneous tissues are normal in color. Serous surfaces are smooth. Trachea is clear. Heart and lungs are negative. Stomach, intestines, and pancreas are normal. Spleen is normal in size. Pulp shows some increased pigmentation. Microscopically the pulp contains many phagocytes loaded with a light brown coarsely granular iron-containing pigment, also many megalocaryocytes. Kidneys are swollen. Microscopically the tubular cells are swollen and granular. Many of the glomerular capsules are filled with coagulated fluid. Mesenteric lymph glands are normal. Bone marrow of femur is deep red and granular. Microscopically it consists chiefly of myeloid tissue with very little fat. The erythroblastic elements are conspicuous. Liver is enlarged and very fatty. The capsule is smooth. The cut section is very greasy and is opaque yellowish brown in color. The lobules are indistinct. Gall bladder and bile ducts are normal. Microscopically all of the liver cells contain large and small fat droplets. The Kupffer cells are inconspicuous. The periportal structures are unchanged.

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TABLE 3.

[20 mg. parazol, per kilo, in olive oil, subcutaneously. One dose only.]

DOG 12.

[Meat diet.]

Day of experiment.	Time.	Food eaten daily.	Body weight.	Clinical symptoms.		Urine.			Feces.	Remarks.
				Character of mucous membranes.	Incoordination.	Color.	Albumin.	Bile pigment.		
	A. M.	*Gms.*	*Kilos.*							
1	9.30	.....	9.5	Normal.....	None..	.....	None.....	None.....	.....	Adult fox terrier, mongrel, male. Active and normal.
	10.10	.....	.....	.....	.....	.....	.....	.....	.....	190 mg. parazol, subcutaneously, in olive oil, 20 per cent solution.
	P. M.									
	12.30	260	.....	Normal.....	None..	Reddish yellow.....	.....	.....	Soft.....	Urine shows no hemoglobin bands in spectrum.
	3.15	.....	.....	Normal, tongue reddish blue.	...do..	.....	.....	.....	.....	Droopy. Edema below site of injection, no tenderness. Pulse, good volume and tension.
	4.30	.....	.....	.....do.....	...do..	Reddish yellow.....	.....	.....	.....	Edematous area below site of injection 12 by 9 cm.
2–6	.....	390	9.1	Normal.....	...do..	Straw.....	+ Slight..	+ Slight..	Hard.....	
8–13	.....	275	8.5	.....do.....	...do..	.....	.....	None.....	Soft.....	
15	.....	290	.....	.....do.....	...do..	.....	.....	+ Slight..	.....do....	Tumor extending from midline of back in band 3 to 10 cm. in breadth, 1 to 5 cm. high over left thorax to sternum. Definite fluctuations. Hair has sloughed off over an area 7½ by 5 cm. in diameter, purple area.
16	.....	280	8.2	.....do.....	...do..	.....	.....	.....	Diarrhea..	Purple area of tumor has sloughed away, opening up cavity. Tumor has gone down. Slough has a clean granulating bottom and sides. No odor.
17	.....	290	.....	Pale.....	...do..	.....	.....	+.....	.....do....	Local reaction; slight discharge of pus, healing.
18–27	.....	275	8.4	.....do.....	...do..	Yellow.....	.....	+.....	Hard.....	Abscess healing.
29–41	.....	275	8.9	Normal.....	...do..	Light brown.....	.....	+.....	...do.....	Local abscess almost healed.
43–53	.....	285	9.1	.....do.....	...do..	.....do.....	.....	None.....	...do.....	Abscess has completely healed.
54–89	.....	315	9.5	.....do.....	...do..	.....do.....	.....	+.....	...do.....	In excellent condition.
90	.....	.....	9.4	.....	.....	.....	.....	.....	.....	Experiment discontinued.

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TABLE 3—Continued.

DOG 12—Continued.

Day of experiment.	Time.	Hb.	Red cells per c. mm.	White cells per c. mm.	Differential count.						Nucleated reds.	Character of reds.	Blood volume.		Plasma.			Methb.	Clot.
					Small monos.	Large monos.	Pmn. n.	Pmn. eos.	Pmn. bas.	Tr.			Plasma.	Total.	Character.	Per cent.	Hemolysis.		
1	A. M. 9.00	P. ct. 111	8,408,000	12,200	P. ct. 23	P. ct. 6	P. ct. 61	P. ct. 9	P. ct.	P. ct. 1	11	Slight basophilia..	c. c. 362	c. c. 804	Amber, clear.....	45	None..	None..	Firm.
	P. M. 12.30	102	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	4.30	94	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
2	.....	104	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
5	.....	93	7,520,000	24,000	11	6	79	2	.....	2	11	Anisocytosis, basophilia.	371	687	Amber, clear.....	50	None..	None[1]	Do.
10	.....	87	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Light brown, clear.	54	None..	None..	Do.
17	.....	92	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Amber, clear.....	56	...do..	...do..	Do.
29	.....	92	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Lipaemia ++....	53	...do..	...do..	Do.
34	.....	94	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
41	.....	98	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
43	.....	102	7,088,000	14,800	10.5	5	73	6.5	.....	5	1	Normal.....	353	738	Amber, clear.....	50	None..	None..	Do.
45	.....	97	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	...do.....	48	...do..	...do..	Do.
54	.....	92	6,696,000	16,200	16	7	75.5	.5	.....	1	21	Slight anisocytosis	384	724	Water, clear.....	53	None..	None..	Do.
59	.....	90	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
64	.....	92	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
67	.....	100	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
72	.....	85	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
76	.....	86	6,232,000	9,600	22.5	.5	75.5	.....	1	.5	13	Anisocytosis.....	454	857	Clear.....	53	.....	.....	.....
90	.....	72	6,928,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....do.....	59	.....	.....	.....

[1] Blood is dark colored. Diffuse absorption of green, blue, violet end of spectrum.

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TABLE 4.

[60 mg. parazol, per kilo, in olive oil, subcutaneously. One dose only.]

DOG 52.

[Meat diet.]

Day of experiment.	Time.	Food eaten daily.	Body weight.	Clinical symptoms.		Urine.			Feces.	Remarks.
				Character of mucous membranes.	Incoordination.	Color.	Albumin.	Bile pigment.		
	A. M.	*Gms.*	*Kilos.*							
1	9 30	.....	12.6	Normal.....	None....	.....	None....	None....	.....	Young adult shepherd mongrel, male.
	10.15	.....	.....	.....	.....	.....	.....	.....	.....	750 mg. parazol, subcutaneously, in olive oil, 20 per cent solution.
	P. M.									
	12.30	380	.....	Normal.....	None....	Yellow, clear.....	.....	++++.	Soft.....	Urine: Absorption of green, blue, violet end of spectrum.
	4.30	.....	.....	.....do.....	...do.....	Straw.....	.....	None....	.....	Oedematous area below the site of injection 12 by 8 cm. No tenderness at site of injection.
2	.....	500	13.3	.....do.....	...do....	Straw, clear.....	None	...do.....	Soft.....	
3–12	.....	475	13.4	.....do.....	...do.....	Orange.....	...do....	++.....	Hard....	
13–15	.....	385	.....	.....do.....	...do.....	.....	.....	++.....	None....	Tumor still present, not tender. No distinct fluctuations. Hair and skin normal over tumor. Some salivation.
16–19	.....	390	13.7	.....do.....	...do.....	.....	.....	+.....	...do.....	Hard tumor.
20–27	.....	400	13.3	.....do.....	...do.....	Yellow.....	.....	++.....	Hard....	Tumor considerably smaller.
29–41	.....	385	12.6	Pale pink.....	...do.....	Light brown.....	.....	++.....	...do.....	Small area of induration left at site of local reaction.
43–50	.....	370	11.2	.....do.....	...do.....	.....do.....	.....	++.....	...do.....	
51	.....	0	.....	Normal.....	.....	.....	.....	.....	...do.....	
52	.....	0	10.6	.....	.....	Light brown.....	.....	None...	None....	
53	.....	0	.....	.....	.....	.....	.....	.....	...do.....	Nervous type of distemper with pneumonia.
54	.....	.....	9.7	.....	.....	.....	.....	.....	.....	9 a. m. found dead.

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TABLE 4—Continued.

DOG—Continued.

Day of experiment.	Time.	Hb.	Red cells per c. mm.	White cells per c. mm.	Differential count.					Nucleated reds.	Character of reds.	Blood volume.		Plasma.			Methb.	Clot.
					Small monos.	Large monos.	Pmn. n.	Pmn. eos.	Tr.			Plasma.	Total.	Character.	Per cent.	Hemolysis.		
	A. M.	*P. ct.*			*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*		*c. c.*	*c. c.*					
1	9.00	100	7,600,000	18,200	13	1	76	9	1	0	Anisocytosis.....	536	1,164	Amber, clear.....	46	None..	None..	Firm.
	P. M.																	
	12.30	99	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	...do.[1]	
	4.30	93	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Amber, clear.....	49	.....	None.	
2	.....	99	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	...do..	
5	.....	78	5,448,000	21,400	15	5	70	5	5	28	Marked anisocytosis, basophilia.	605	1,024	Light brown, clear.	59	None..	...do..	Do.
9	.....	70	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Amber, clear.....	61	...do..	...do..	Do.
17	.....	75	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....do.....	60	...do..	...do..	Do.
34	.....	84	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
41	.....	81	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Amber, clear.....	.....	None..	None..	Do.
43	.....	80	5,096,000	7,600	6	2	85	3	4	2	Normal.....	597	948	.....do.....	63	...do..	...do..	Do.
45	.....	77	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
52	.....	75	5,320,000	11,200	4.5	1	91.5	.5	2.5	1	Slight anisocytosis.....	466	817	Amber, clear.....	57	None..	None..	Do.

[1] Blood is dark. Absorption of green, blue, violet end of spectrum.

October 18, 1918.—Autopsy.—Dog is somewhat emaciated. Oral mucous membrane and conjunctivae are intact. No icterus or mange. Subcutaneous and omental fats are normal in color. Heart is normal. Lungs show extensive bronchopneumonia. The middle lobe of the right lung is completely consolidated, and its pleural surface is covered with a fibrinous exudate. Stomach and intestines are negative. Pancreas, adrenals, and kidneys are normal in gross and in sections. Spleen is swollen. On section the pulp is velvety and deep purplish red. Microscopically the venules are distended. The pulp is heavily stippled with phagocytes loaded with hemosiderin. Mesenteric lymph glands are normal. Bone marrow of femur is hyperplastic. Liver is swollen and congested. The capsule is smooth and bulges on section. The gall bladder and bile ducts are normal. Microscopically the liver cells are swollen and granular. No scarring. The capillaries contain a few pigmented endothelial cells.

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TABLE 5.

150 mg. parazol, per kilo, in olive oil, subcutaneously. One dose only.

DOG 53.

[Meat diet.]

Day of experiment.	Time.	Food eaten daily.	Body weight	Clinical symptoms.		Urine.			Feces.	Remarks.
				Character of mucous membranes.	Incoordination.	Color.	Albumin.	Bile pigment.		
	A. M.	*Gms.*	*Kilos.*							
1	9.30	.....	10.3	Normal.	None....	Light yellow.....	None....	None.....	.....	Young adult bullterrier mongrel, male. Excellent condition.
	10.20	.....	.....	.....	.....	.....	.....	.....	.....	1,545 mg. parazol, subcutaneously, in olive oil, 20 per cent solution.
	P. M.									
	12.30	465	.....	Blanched	None....	Reddish brown.....	.....	+.....	.....	
	3.15	.....	.....	...do.....	...do.....	.....	.....	.....	.....	Large oedematous patch below site of injection, no tenderness. Droopy. Pulse, good volume and tension.
	4.30	.....	.....	...do.....	...do.....	Orange.....	.....	++.....	Soft.....	Oedematous patch 15 by 20 cm. below site of injection.
2	.....	480	10.8	Pale....	...do.....	Yellow, clear.....	.....	None.....	...do.....	
3–13	.....	425	11.0	...do.....	...do.....	Orange.....	None....	+Slight...	...do.....	
15–16	.....	385	11.5	...do.....	...do.....	.....	.....	None.....	...do.....	Two sloughs over tumor, one 4 by 3 cm. in diameter, the other 2 by 1 cm. yellowish gray. No odor. No tenderness. No fluctuation.
17–18	.....	390	.....	...do.....	...do.....	Light straw.....	.....	...do.....	...do.....	Skin lesion shows slight discharge of yellow fluid and is granulating.
19	.....	300	11.1	...do.....	...do.....	Deep brown.....	.....	+.....	Hard....	Abscess sloughing.
20	.....	.....	10.6	.....	.....	.....	.....	.....	.....	10.25 a. m., killed with chloroform.

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TABLE 5—Continued.

DOG 53—Continued.

Day of experiment.	Time.	Hb.	Red cells, per c. mm.	White cells, per c. mm.	Differential count.					Nucleated reds.	Character of reds.	Blood volume.		Plasma.			Methb.	Clot.
					Small monos.	Large monos.	Pmn. n.	Pmn. eos.	Tr.			Plasma.	Total.	Character.	Per cent.	Hemolysis.		
1	A. M. 9.00	P. ct. 99	8,512,000	9,400	P. ct. 20	P. ct. 6	P. ct. 64	P. ct. 9	P. ct. 1	0	Anisocytosis....	c. c. 453	c. c. 888	Amber, clear.....	51	None.	None.	Firm.
	P. M. 12.30	80	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
	4.30	92	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
2	.....	94	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
5	.....	78	6,248,000	17,000	11	5	73	9	2	0	Anisocytosis....	493	836	Amber, clear.....	52	.....	None.	
10	.....	62	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Light brown, clear.....	59	None.	...do..	
17	.....	77	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Lemon yellow, clear.....	56	...do..	...do..	Do
20	.....	72	5,488,000	10,400	29	3	36	.....	32	3	Anisocytosis....	471	841	Lipæmia++	57	...do..	...do..	Do.
														Amber, clear.....	56	...do..	...do..	Do.

September 14, 1918.—Autopsy.—Dog is fairly well nourished. Oral mucous membrane and conjunctivæ are intact. No icterus. Over the right thorax and just below the site of the parazol injection there is a large undermined ulcer. The skin opening is 6 cm. in diameter, leading into an undermined area 12 by 18 cm. The granulating surface is covered with a foul-smelling sero-purulent exudate. The subcutaneous and omental fats are abundant and normal in color. No excess of serous fluids. Heart and lungs are negative. Stomach, intestines, and pancreas are normal. Kidneys are pale and swollen. Microscopically the tubular cells are swollen and granular. Spleen is somewhat enlarged. The pulp is velvety and purplish red. The Malpighian bodies stand out conspicuously as translucent gray pinhead dots. Microscopically the venules are distended. The Malpighian bodies are large and show a few areas of coagulation necrosis. Bone marrow of femur is mottled gray and pink. Microscopically the myeloid tissue is moderately abundant. The erythroblastic elements are conspicuous. Liver is swollen and pale. The capsule is smooth. The cut section is opaque yellowish brown. The lobules are indistinct. The gall bladder and bile ducts are normal. Microscopically the liver cells are swollen, very granular, and many contain fat droplets. No scarring. No pigmented phagocytes.

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TABLE 6.

[150 mg. parazol. per kilo, dissolved in olive oil, per os. One dose only.]

DOG 57.

[Meat diet.]

Day of experiment.	Time.	Food eaten daily.	Body weight.	Temperature (rectal).	Clinical symptoms.		Urine.			Feces.	Remarks.
					Character of mucous membranes.	Incoordination.	Color.	Albumin.	Bile pigment.		
	A. M.	*Gms.*	*Kilos.*	° *C.*							
1	9.30	.....	11.9	.....	Normal.....	None....	Yellow, cloudy.....	None.....	None.....	.....	Young adult bull mongrel, male. Active and normal.
	10.30	.....	.....	.....	.....	.....	.....	.....	.....	.....	1,785 mg. parazol, per os, in olive oil, 20 per cent solution.
	11.30	.....	.....	.....	Blanched, tongue reddish blue.	.....	.....	.....	.....	.....	Animal is continually retching.
	M. 12.00	.....	.....	.....	.....	.....	.....	.....	.....	.....	Vomits small amount greenish frothy mucous fluid.
	P. M. 12.10	.....	.....	.....	.....	.....	.....	.....	.....	.....	Vomits bile stained fluid.
	12.30	.....	.....	.....	.....	.....	Reddish brown.....	.....	++.....	.....	Urine shows diffuse absorption of green, blue, and violet end of spectrum.
	1.30	.....	.....	.....	.....	.....	.....	.....	.....	.....	Some twitching of eyelids.
	3.15	.....	.....	.....	Tongue reddish blue..	.....	.....	.....	.....	.....	Twitching of eyelids and muscles of hind legs. Droopy. Pulse of good volume and tension.
	4.30	395	.....	.....	Blanched, tongue reddish blue.	None....	Red.....	None.....	None.....	Soft.....	Blood chocolate colored. Some muscular rigidity. Twitching of eyelids.
2	.....	(	10.9	.....	Pale.....	....do...	Light brown.....	+ Slight..	+.....	None....	
3	.....	400	.....	.....	....do.....	....do...	Reddish yellow.....	None.....	++++++	...do....	
4–12	.....	400	10.7	.....	....do.....	....do...	Straw cloudy.....	....do....	+.....	Soft.....	
13–19	.....	395	10.7	37.8	....do.....	....do...	Yellow.....	.....	None.....	...do....	Lively.
23	.....	200	9.2	.....	....do.....	....do...	Light yellow.....	.....	+.....	Hard....	Droopy. Losing weight.
24	.....	.....	9.1	.....	.....	.....	.....	.....	.....	.....	8 a. m. found dead.

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TABLE 6—Continued.

DOG 57—Continued.

Day of experiment.	Time.	Hb.	Red cells per c. mm.	White cells per c. mm.	Differential count.					Nucleated reds.	Character of reds.	Blood. Volume.		Plasma.			Methb.	Clot.
					Small monos.	Large monos.	Pmn. n.	Pmn. eos.	Tr.			Plasma.	Total.	Character.	Per cent.	Hemolysis.		
		Per cent.			Per cent.	Per cent.	Per cent.	Per cent.	Per cent.			c. c.	c. c.					
1	A. M. 9.00	99	6,944,000	18,600	17	4	65	11	3	0	Normal.....	574	1,221	Lipaemia ++.....	47	None..	None.	Firm.
	P. M. 12.30	103	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	...do..	
	4.30	106	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	++	
2	.....	103	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Amber, clear.....	40	None..	None.	Do.
5	.....	85	8,552,000	23,200	14	4	72	6	4	3	Slight anisocytosis....	499	960	Light brown, clear..	52	...do....	...do...	Do.
10	.....	77	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Amber, clear.....	59	...do....	...do...	Do.
17	.....	93	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Lipaemia ++	49	...do....	...do...	Do.

September 18, 1918.—Autopsy.—Dog is fairly well nourished. No icterus. Heart is normal. Trachea is clear. Lungs show several small areas of bronchopneumonia in posterior lobe of right lung and a few scattered through the left lung. Stomach and intestines are negative. Spleen is somewhat swollen. Microscopically the venules are distended with red cells. Malpighian bodies stand out conspicuously and show a few small areas of coagulation necrosis. Kidneys are swollen. Microscopically the tubular cells are swollen and granular. Many of the glomerular capsules contain coagulated fluid. Bone marrow of femur is deep red and granular. Microscopically it is hyperplastic and quite vascular. Some fat. A few pigmented phagocytes. Liver is swollen. Gall bladder and bile ducts are normal. Microscopically the liver cells are swollen, granular, and contain a few fat droplets. No scarring. No pigmented endothelial cells.

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III. MERCURY FULMINATE AS A SKIN IRRITANT.[1]

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INTRODUCTION.

Howard is credited with the discovery of mercury fulminate in 1799, but owing to its highly explosive property, several years passed before Kekulé determined its structure to be $Hg(CNO)_2$. In 1815 Joseph Egg employed this compound in the production of percussion caps, and thus the use of the flintlock for the ignition of gunpowder began to disappear. In spite of the many attempts to replace it on account of the frequency of accidents due to its sensitivity, it is still almost universally used as the initiating compound in the munition industry (1).

Preparation and physical properties.—The use of mercury fulminate in the manufacture of munitions for any purpose other than as a detonator is precluded by its sudden and very violent explosive property. According to Berthelot and Vieille (2) the pressure produced by the detonation, when the containing space is filled, is found to be more than twice that produced by the detonation of nitroglycerine and about three times that of guncotton. Upon this pressure coupled with the extreme rapidity of the explosion, depends its superiority as a detonator.

Mercury fulminate may be made by several different methods, but commercially Chandelon's process is almost universally used. It consists essentially in mixing alcohol and a solution of mercury in an excess of nitric acid at a temperature of about 55° C. This is always done on a small scale and sometimes out of doors where the best of ventilation is procured, but at best it is attended with a constant danger of accidental explosion and serious injury to the workmen. The fulminate precipitates as a grayish-white crystalline substance having a specific gravity of 4.42, soluble in alcohol, pyridine, potassium cyanide, ammonia, concentrated hydrochloric acid, sodium thiosulphate and to about 0.1 per cent in water at body temperature (3). In cold water it is almost insoluble, while in boiling water it is soluble to the extent of about 0.77 per cent. When stored it is

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placed in small linen bags and kept under water which renders it much less sensitive. It will, however, explode with tremendous violence even though thoroughly soaked with or sunk under water (4), if only a small amount of dry fulminate is exploded while in contact with or near it. When required in the dry form the precipitated crystals are spread out on linen, supported by wooden frames and dried in vacuum at a temperature not greater than 40° C. In the dry state it is very easily ignited by friction or by heat. For the filling of detonator caps, it has been mixed with various chemical compounds such as black powder, compositions containing sulphur, sulphide of antimony, lead picrate, potassium chlorate, or powdered glass. This mixing is often a dusty process which requires great care in its manipulation. According to Colver (5) potassium chlorate is the only admixture which is now used to any extent and the proportions of potassium chlorate are generally 5, 10 or 20 per cent. The object of this mixture is to decrease to a certain extent the violence and to increase the heat of the explosion. Kober and Hanson (6) state that some mixtures contain as much as 45 per cent of glass dust, 35 per cent fulminate of mercury, 16 per cent chlorate of potash, 2 per cent gum arabic, 2 per cent gum tragacanth. Alice Hamilton (7) mentions that, in factories of this country, the substances added to the fulminate to make up the charge include chlorate of potash, antimony sulphide, ground glass, and sometimes sulphur. She also states that in factories manufacturing small arms, the workers are exposed to this fulminate dust where the process of filling the caps is carried out.

Dermatitis and systemic poisoning among workers.—Oliver (8) states that on account of exposure to the dusty process in some factories, he has seen both forearms of a workman the seat of dry eczema, extremely itchy and slow to heal. Workers occasionally suffer from irritation of the skin of the face and swollen eyelids from the fulminate powder. According to Hamilton (7) there is a large amount of fulminate dermatitis among the workers who do the loading, pressing, and inspecting of the primed shells. A decided difference in the susceptibility of individuals is evident, which is supposed by some to be due to a difference in the amount or character of the perspiration, since it can not be explained by a difference in personal cleanliness or precautions used by the workers. The dermatitis sometimes takes the form of a painful and disfiguring eruption of the skin usually resembling moist eczema. The skin is reddened, swollen, and tense, exuding serum, and finally scaling or forming a scab. Severe cases develop swelling of eyelids and fingers. Instances where the whole body is involved are seldom reported. The most usual parts affected are the hands and forearms. The relative proportion of the various skin regions affected is shown by a report of 61 cases of poisoning

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among whom were 3 with an involvement of the hands, 5 of the face, 3 of the eyelids, 33 of the forearms and hands, and 16 of the face and arms. In another report, Hamilton shows women to be much less susceptible than men, possibly because they take more pains to avoid a disfigured complexion. Of 1,070 women only 32 cases developed, while of 505 men 36 cases were reported (9).

Although not often diagnosed as such in this country, cases of typical systemic mercurial poisoning are reported by Oppenheim (10) who states that among Austrian workers there were 13 persons with fulminate dermatitis, 8 of whom had "stomatitis mercurialis," bleeding gums, and salivation. Heinzerling (11) reports that about 40 per cent of the female workers in a Nuremberg factory have suffered from mercurial poisoning due to the inhalation of mercury fumes developed by the "tiny explosions" in the pressing and filling process. Neisser (12) also reports cases of systemic poisoning which occurred in a factory in Marseilles.

The report of the British Health of Munition Workers' Committee (13) in reference to mercury fulminate being significant, and briefly stated, is quoted in full as follows:

In the manufacture and use of fulminate of mercury there is liability of mercuria poisoning and eczema. Owing, however, to the small amounts manipulated, the symptoms of mercurialism are seldom marked, but a blue line may be seen on the gums, appetite may be impaired, headache may be present, and there may be nervousness and depression. The last symptom is important not merely as a sign of illness but as an indication that the operative should be removed from dangerous work which calls for a steady hand and a clear head. Eczema of the hands, forearm, and face occurs and may cause serious disability. A medical examination of 60 women workers employed on manipulating substances containing mercury fulminate showed that only 5 had remained in good health throughout their work at the factory. The most common symptoms were rash on face and hands (41.6 per cent) often associated with severe intestinal pains, sickness, and diarrhea (30 per cent). The eyes are often affected, either with conjunctivitis (35 per cent) or inflamed lids (20 per cent). Soreness of mouth and gums occurred in 21.6 per cent though salivation was infrequent (7 per cent) and a blue hue on gums was only noticed in two instances. Workers complained of the difficulty caused by soreness of the mouth, as this affected their appetite and was most painful if artificial dentures were worn. Disorders of menstruation occurred in 20 per cent of those examined and depression was marked in 25 per cent. Sleeplessness was generally due to the irritation produced by the rash, probably increased by the fact that at least 25 per cent of the women admitted that they slept in some clothes worn during the day. It was ascertained that 41.6 per cent wore neither veil nor respirator, although in about 30 per cent the onset of symptoms was associated with sneezing or signs of "cold" due to the inhalation of the mercurial powder. The greatest susceptibility was shown in the case of a woman in whom mere contact with a mercury worker wearing a dirty overall was sufficient to produce a rash. Rashes were more severe in those women who did not wear veils or respirators. It was noted that one worker who remained immune for two months habitually used a veil, respirator, and goggles, though it can not be said that these effected complete protection. The principal preventive measures to be adopted should include (*a*) the provision of overalls and of adequate cloak and washing accommodations; (*b*) adequate

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facilities for obtaining food. No worker should be allowed to commence work without food; (*c*) careful selection of workers; (*d*) where exposure is marked, periodic medical examination; (*e*) transference to other work of those especially affected.

The only treatment suggested seems to be that reported by Hamilton (7) who says that at the United States Arsenal at Frankford the men who handle fulminate are given carbolized vaseline to rub on the skin after washing. For fulminate itch, an ointment is made of balsam of Peru, with zinc oxide ointment, and a little carbolic acid.

EXPERIMENTAL PART.

The very great increase in the manufacture and use of mercury fulminate in this country as the war went on led to an increase in the number of workmen affected. In some cases the workers were incapacitated or their efficiency reduced to such an extent that it became desirable to recommend some protective measure. No published work on this phase of the subject being available, an experimental study on animals was begun.

Dermatitis in rabbits.—White rabbits were chosen because of the relatively sensitive skin, and because of the color on which a slight effect could be observed. Although rabbits show an individual variation in their susceptibility to mercury fulminate as a skin irritant, in general the effects are quite constant under similar conditions.

When a rabbit's skin is carefully shaved and as much as 50 mg. of mercury fulminate applied directly and held in place for two or three hours or more and then removed, a marked lesion is almost invariably produced, which shows a thickening to two or three times that of normal skin; a blanching so that in many cases the skin is almost white, with an erythematous zone surrounding the blanched area; and almost without exception a marked edema is present over a wide area around the lesion, but usually is later in appearing than the above-mentioned effects. A few hours later or at least by the following day the blanching has been replaced by a hemorrhagic condition while the edema and erythema become more pronounced. By the second day the edema usually begins to disappear, and the skin which was at first blanched becomes extremely dry and indurated. As far as can be seen by gross examination, all the structures of the skin are involved in this process. The recovery during which desquamation takes place requires two weeks or longer, depending upon the extent and severity of the lesion.

When applications are left on the skin longer than two hours, as for example over night or when 100 mg. instead of 50 mg. are used, the injury produced is more extensive and more severe. Cases in which rabbits are shaved and a day or two allowed to intervene before the application of mercury fulminate often show no effect, while

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those affected are less severe than in cases where the application had been made immediately after shaving (Columns 2 and 6, Table I).

Barium sulphide was sometimes used for removing the hair and, on animals where the hair was thus removed from one side and the other side shaved, an application of mercury fulminate was usually less effective on the side where barium sulphide was employed (Animals 65 to 69, columns 1 and 6, Table I). This is not due in any way to a neutralizing action of the barium sulphide, as may be shown by shaving two areas on the same animal and applying to one the barium sulphide in the same way as if used to remove the hair. If now an equal amount of mercury fulminate is applied to both areas for an equal length of time, the resulting lesions are of the same intensity on both areas (columns 6 and 30, Table I). Barium sulphide alone if not left on the skin any longer than necessary to remove the hair and then thoroughly washed off, apparently leaves the skin in a condition which absorbs mercury fulminate less readily on account of the lesser injury to the skin than when it is carefully shaved.

The question arose as to whether or not the amount of perspiration could be responsible for the variation in effect among workmen. A few experiments were therefore performed in which a comparison was made between the effects of mercury fulminate applied in the dry state and that applied in the moist form and kept moist by a cotton pad soaked with water. In so far as the results of these experiments can be taken as an indication, there is no distinct difference between the dry and moist forms (Columns 6 and 24, Table I).

The results of external applications on rabbits were supplemented by the use of eight dogs. These dogs were found to be much less sensitive than rabbits. In other respects, however, the lesions were quite similar. Marshall and Smith (14) in experiments with mustard gas report dogs to be more sensitive than rabbits.

Mercury fulminate applied to human skin.—In addition to these experiments on animals, 12 different coworkers in this laboratory submitted themselves to applications of 10 mg. quantities of mercury fulminate. The applications were made to the dorsal surface of the left forearm in all cases and held in place by a small disk of glazed paper covered by cotton and secured by strips of adhesive for periods varying from 12 to 48 hours. In no case was the slightest effect to be seen on the skin, and all agree that not the least sense of pain was noticed. Mention should be made of the fact that in all areas exposed the skin was apparently in perfect contact.

The writer has also subjected himself to numerous applications in various forms, such as the dry crystals, those moistened and covered by a cotton pad soaked with water and completely sealed on by a

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large covering of adhesive, and in other cases fulminate mixed with olive oil. The period of application varied, but was usually 24 hours or more. In no case have these applications produced any perceptible effect. It should be kept in mind, however, that these experiments, either with animals or in case of applications to the human skin, are not identical with the conditions encountered in munition factories. The workmen in factories, unless great care is taken to thoroughly remove the fulminate, are probably exposed to small quantities about the hair follicles for a much longer time, and in addition the friction of the clothing may undoubtedly facilitate entrance of the poison into the skin, especially among those who sleep in some of their working clothes. In the experiments on human skin, as just mentioned, the applications were held firmly in place with practically no friction and thoroughly removed at the end of approximately 24 hours. In case of rabbits the skin, not accustomed to exposure of any kind, is very sensitive and even by the most careful methods of shaving is undoubtedly injured to a greater or less extent. The animal experiments and also the factory reports of workmen seem to show a great variation of individual susceptibility, and this is to be expected since we know that the skin of various persons varies in susceptibility to many other substances, though some other at present not recognized factors may account for our failure.

Systemic effect in rabbits.—In only a few rabbits which died soon after the application of mercury fulminate did necropsy reveal on gross examination any lesions of the intestinal tract or kidneys which might possibly be attributed to mercury poisoning. If mercury was the cause of death in these few cases it may have been inhaled from evaporation, swallowed by mouth after licking the bandages or taken in some other manner. At least no evidence at hand would justify the conclusion that mercury fulminate was absorbed by the skin in sufficient quantities to produce death.

A considerable number of tests were also made for the detection of mercury in the urine after application of mercury fulminate to the skin, but in no case was any found.

In a series of about 24 rabbits, amounts of mercury fulminate varying from 10 to 100 mgs. per kilo were given in the dry form by mouth in gelatin capsules. A rather wide range of variation as to the lethal dose was observed. This may be in part accounted for by the fact that no allowance was made for any variation in the weight of contents of the intestinal tract, which, as previously shown (15), may be appreciable. The averages would indicate that the minimal lethal dose is usually in the neighborhood of 20 mgs. per kilo.

Preventive measures.—Some unpublished work by Dr. George F. White of this laboratory has shown that a shellac skin varnish is of

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some value in the prevention of certain skin lesions. In order to test out the protective action of this varnish against fulminate dermatitis 32 rabbits were used. Two areas were shaved on the same animal and two coats of orange shellac (consisting of 6 parts shellac, 1 part of castor oil, and 24 parts of alcohol) were applied to one area and allowed to dry. Both areas were then exposed to an equal amount of mercury fulminate for an equal length of time. On no area where shellac had been used was there produced the most severe type of lesion. In only 8 cases was there even a distinct lesion on the area protected by the shellac; 14 showed very slight effects; and in 9 cases no effect could be observed. On the corresponding areas not thus protected 14 showed the most severe type of lesion, 8 showed distinct lesions, varying in severity, 3 showed only a slight effect, and 6 no effect on either side. It is thus quite apparent that two coats of shellac act as an appreciable barrier to mercury fulminate under these conditions (Columns 6 and 12, Table I.).

Sodium thiosulphate being one of the substances which readily dissolves and decomposes mercury fulminate, it seemed reasonable to assume that it might be used as a treatment to allay the effects following an exposure to this substance. Accordingly in several cases two areas were shaved on the same animal and an equal amount of fulminate applied to each area. As soon as the slightest effect could be detected both applications were removed and to one area a pad soaked with a 10 per cent solution of sodium thoisulphate was applied and held in place. No difference could be detected in the progress of the lesions on the two sides, and recovery required approximately the same time. It is therefore concluded that sodium thiosulphate is of no value as a treatment after injury has been produced (Columns 6 and 18, Table I.). It seems possible, however, that if a practical test were made among workmen, using a solution of sodium thiosulphate as a wash for the purpose of completely removing the fulminate which is practically insoluble in water, we might expect beneficial results. It is quite probable that small amounts of the fulminate which accumulate about the hairs and remain in contact with the skin even after washing in water may be responsible for much of the rash produced.

SUMMARY.

From the observations mentioned, it seems evident that the most important factor concerning the effect of mercury fulminate on the skin of rabbits or man is the condition of the skin itself. In some cases, nature has apparently endowed the skin with more resistance, while in other cases the skin has probably been better cared for and

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thus acts as a better protection. When the skin of rabbits is shaved and a day or two allowed to intervene before the application of mercury fulminate, less effect is produced than when the application is made immediately after shaving. This is probably due to the fact that repair of slight damages has taken place.

When the skin is well covered with shellac there is no doubt, from the experimental evidence, that mercury fulminate is less effective. It does not necessarily follow that shellac applied in this manner would be of practical use among workmen, but some adaptation of this method either to the skin or to the clothing may give beneficial results.

Barium sulphide as used in these experiments, when thoroughly washed off immediately, is usually followed by less effect by mercury fulminate than when the skin is carefully shaved. This fact is due not to any neutralizing action of the barium sulphide but to the condition of the skin, the skin having suffered less from barium sulphide than from shaving.

Sodium thiosulphate which readily dissolves mercury fulminate is of no value as a treatment after injury has been produced, but may prove of benefit as a wash for completely removing the fulminate crystals which are practically insoluble in water.

No definite systemic poisoning such as occurs among workers was shown to follow the limited skin applications of mercury fulminate in rabbits.

No difference has been shown by these experiments in the reactions following applications of dry and moist forms of mercury fulminate.

A rather wide range of individual variation in susceptibility appears among rabbits.

Mercury fulminate applied to the human skin under laboratory conditions has shown no perceptible effect.

Dogs appear to be less sensitive to mercury fulminate than rabbits.

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TABLE I.

*=Hair removed by use of barium sulphide. LD=Left dorsal. RD=Right dorsal. LV=Left ventral. RV=Right ventral.

Mercury fulminate.						Mercury fulminate preceded by two coats shellac.						Mercury fulminate followed by sodium thiosulphate.						Mercury fulminate kept moist by pad with water.						Mercury fulminate; skin shaved and BaS applied as if to remove hair.					
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
35	1	100	LV	21	++++.	35	1	100	RV	21	+																		
37	1	100	LD	24	++++.	37	1	100	RD	24	−																		
38	1	100	LD	18	−	38	1	100	RD	18	−																		
*37	48	100	LD	72	−	19	1	75	LD	48	−																		
37	48	100	LV	72	−	19	1	75	RD	48	−																		
43	1	100	LD	18	−	43	1	100	RD	18	−																		
44	1	100	LD	17	++++.	44	1	100	RD	17	−																		
20	1	75	RD	2	+							20	1	75	LD	2	++.												
21	1	75	RD	1	++							21	1	75	LD	1	++.												
23	1	75	RD	2	++							23	1	75	LD	2	++.												
8	1	100	LD	18	+													8	1	100	RD	18	+						
18	1	100	LD	19	−													18	1	100	RD	19	+						
*24	96	100	LD	23	−													24	72	100	RD	22	−						
*25	48	100	LD	23	−													25	24	100	RD	22	+						
*26	48	100	LD	22	−													26	24	100	RD	22	+						
*27	48	100	LD	22	−													27	24	100	RD	22	−						
*28	48	100	LD	21	−													28	24	100	RD	21	−						
20	24	100	LV	24	−																			20	24	100	RV	24	+++
21	24	100	LV	24	++																			21	24	100	RV	24	+++
23	24	100	LV	24	+																			23	24	100	RV	24	+
26	1	100	LV	22	++++.																			26	48	100	RV	24	++++
28	1	100	LV	22	++++.																			28	48	100	RV	24	++++

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HYGIENIC LABORATORY BULLETINS OF THE PUBLIC HEALTH SERVICE.

The Hygienic Laboratory was established in New York, at the Marine Hospital on Staten Island, August, 1887. It was transferred to Washington, with quarters in the Butler Building, June 11, 1891, and a new laboratory building, located in Washington, was authorized by act of Congreess March 3, 1901.

Of the bulletins published by the laboratory since its establishment, copies of the following are available for distribution and may be obtained without cost by applying to the Surgeon General, United States Public Health Service, Washington, D. C.

No. 2.—Formalin disinfection of baggage without apparatus. By M. J. Rosenau.

No. 43.—The standardization of tetanus antitoxin (an American unit established under authority of the act of July 1, 1902). By M. J. Rosenau and John F. Anedrson.

No. 46. *Hepatozoon perniciosum* (n. g., n. sp.); a hæmogregarine pathogenic for white rats; with a descrpition of the sexual cycle in the intermediate host, a mite (*Ielaps echidnimus*). By W. W. Miller.

No. 50.—Further studies upon the phenomenon of anaphylaxis. By M. J. Rosenau and John F. Anderson.

No. 51.—Chemical tests for blood. By Joseph H. Kastle.

No. 52.—Report No. 3 on the origin and prevalence of typhoid fever in the District of Columbia (1908). By M. J. Rosenau, Leslie L. Lumsden, and Joseph H. Kastle.

No. 55.—Quantitative pharmacological studies; adrenalin and adrenalinlike bodies. By W. H. Schultz.

No. 59.—The oxidases and other oxygen catalysts concerned in biological oxidations. By Joseph Hoehing Kastle.

No. 65.—Facts and problems of rabies. By A. M. Stimson.

No. 73.—The effect of a number of derivatives of choline and analogous compounds on the blood pressure. By Reid Hunt and R. de M. Taveau.

No. 76.—The physiological standardization of ergot. By Charles Wallis Edmunds and Worth Hale.

No. 78.—Report No. 4 on the origin and prevalence of typhoid fever in the District of Columbia (1909). By L. L. Lumsden and John F. Anderson. (Including articles contributed by Thomas B. McClintic and Wade H. Frost.)

No. 81.—Tissue proliferation in plasma medium. By John Sundwall.

No. 86.—Studies on typhus. By John F. Anderson and Joseph Goldberger.

No. 87.—Digest of comments on the Pharmacopœia of the United States of America (eighth decennial revision) and on the National Formulary (third edition) for the calendar year ending December 31, 1911. By Murray Galt Motter and Martin I. Wilbert.

No. 89—Sewage pollution of interstate and international waters with special reference to the spread of typhoid fever. VI. The Missouri River from Sioux City to its mouth. By Allen J. McLaughlin.

No. 91.—The cause of death from subdural injections of antimeningitis serum. By Worth Hale. II. Some new cholera selective media. By Joseph Goldberger.

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No. 94.—I. Collected studies on the insect trasnmission of *Trypanosoma evansi*. By M. Bruin Mitzmain (Bruce Main). II. Summary of experiments in the transmission of anthrax by biting flies. By M. Bruin Mitzmain (Bruce Main).

No. 95.—Laboratory studies on tetanus. By Edward Francis.

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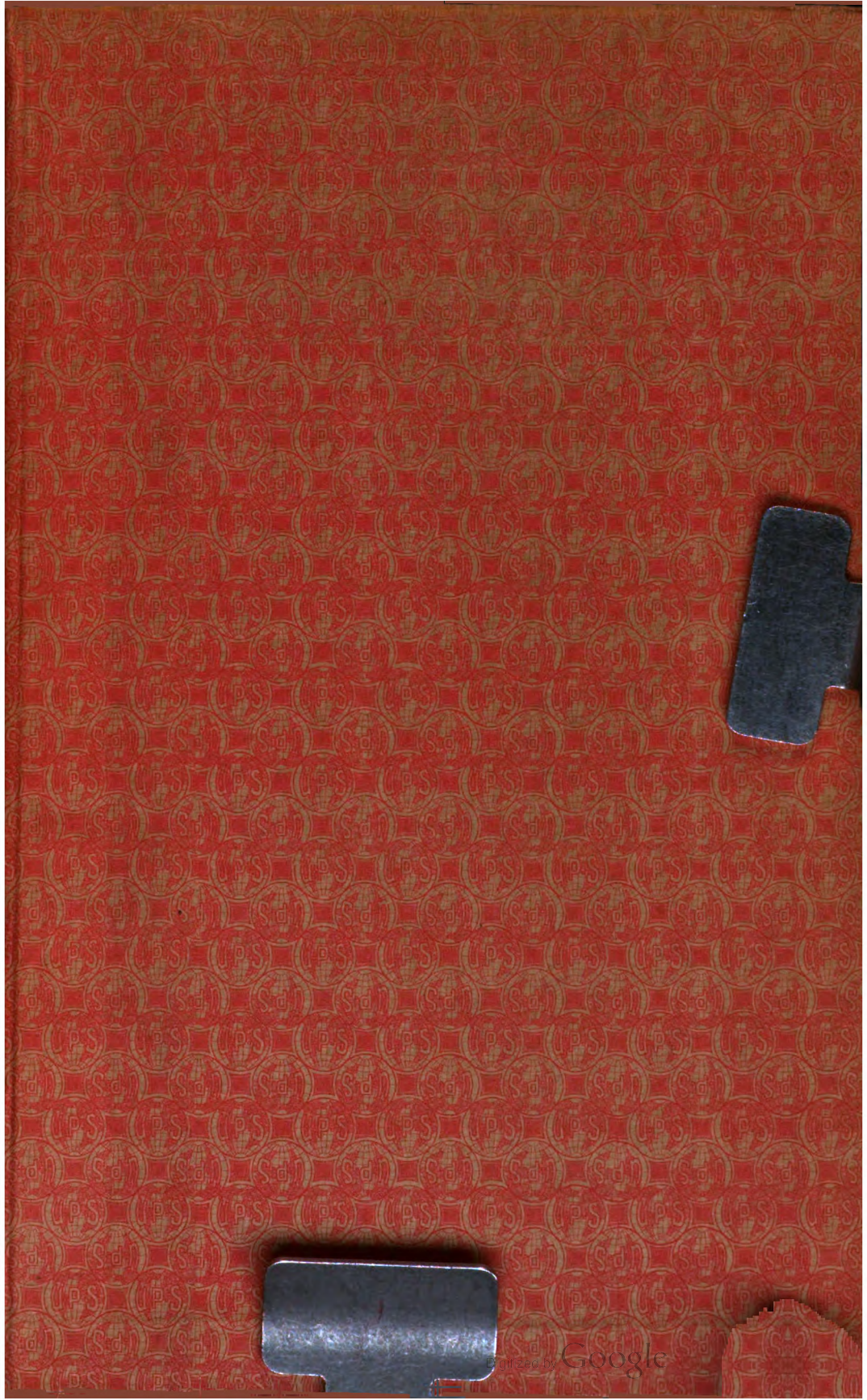
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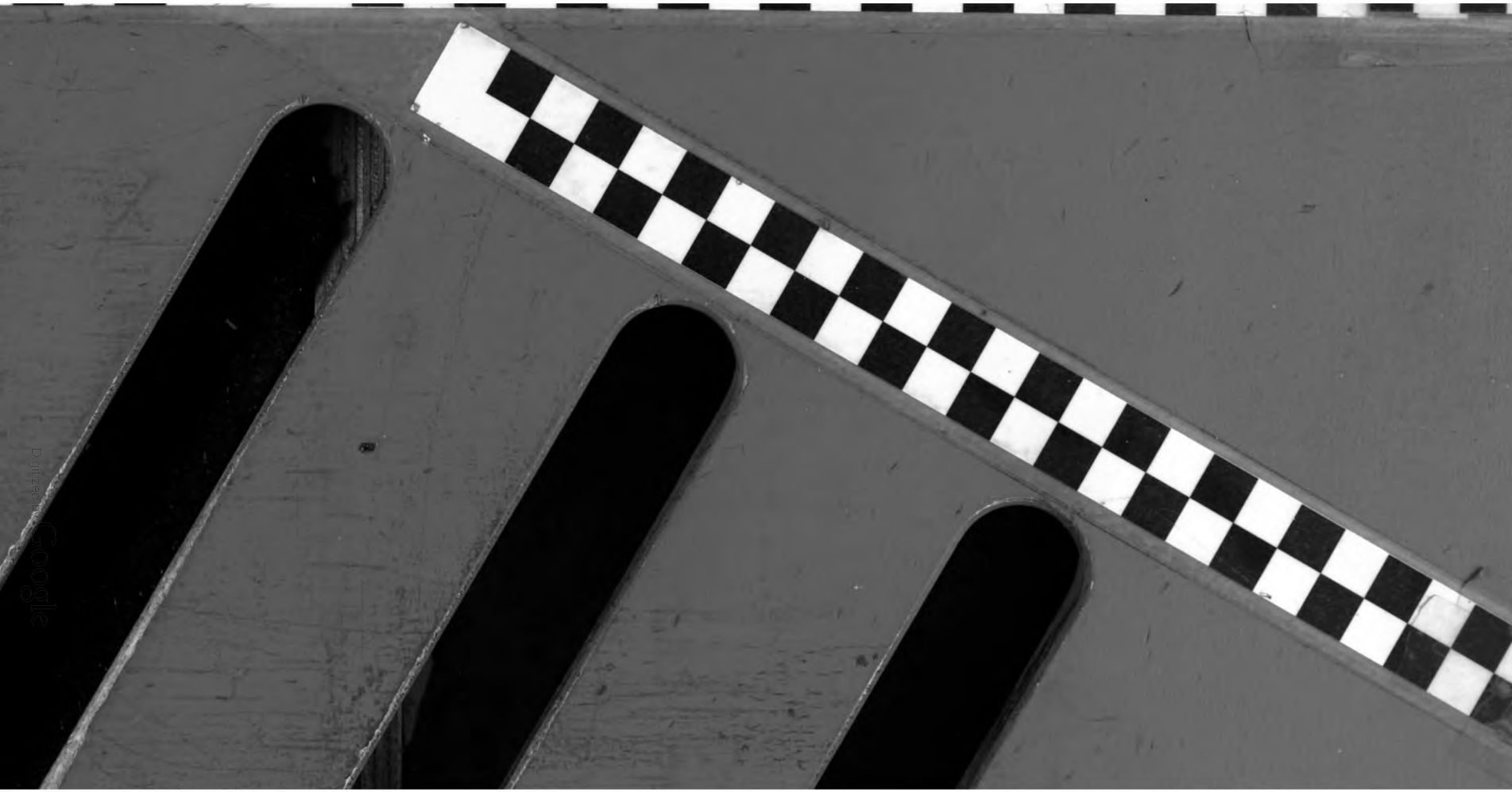

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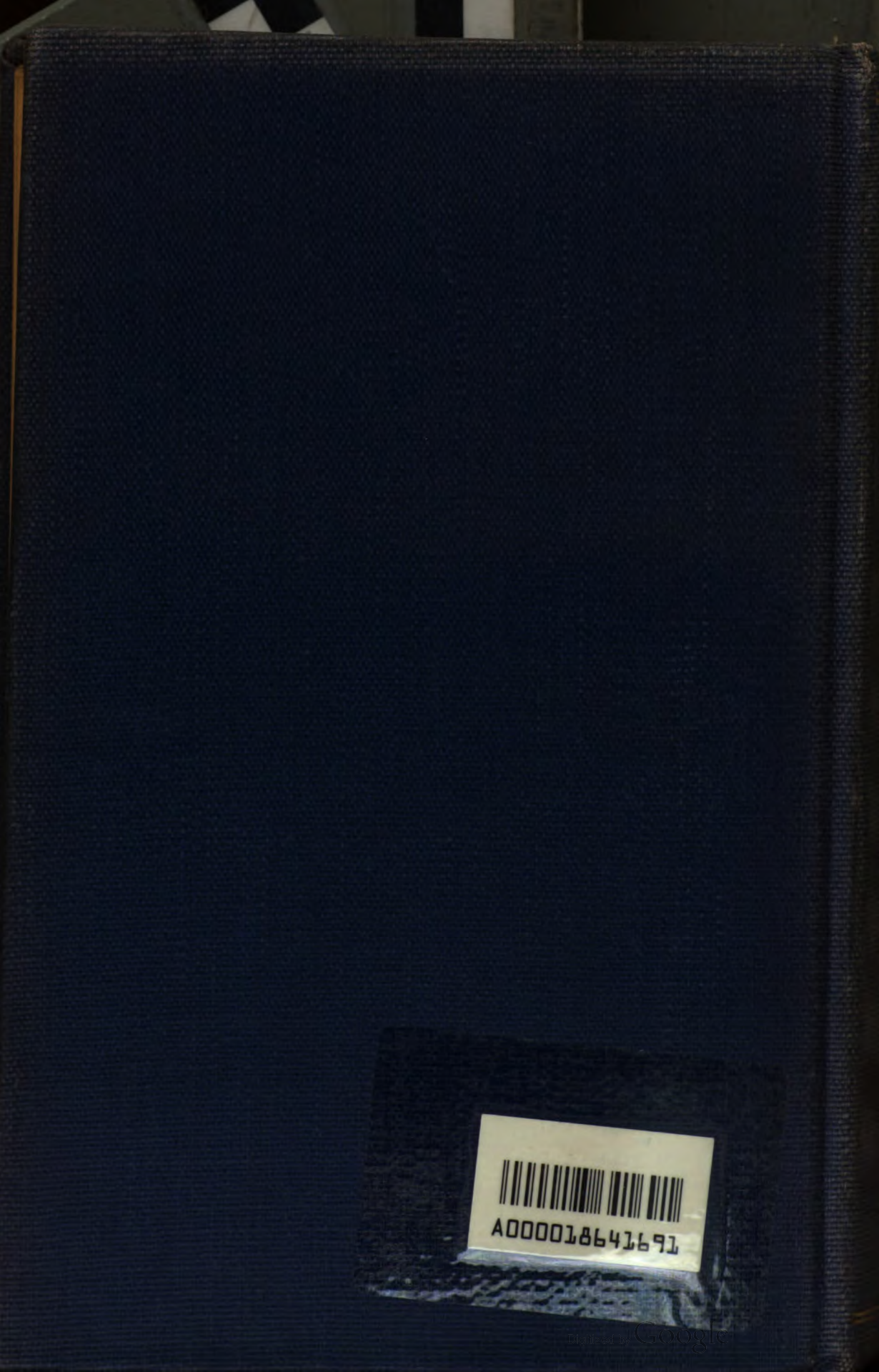
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